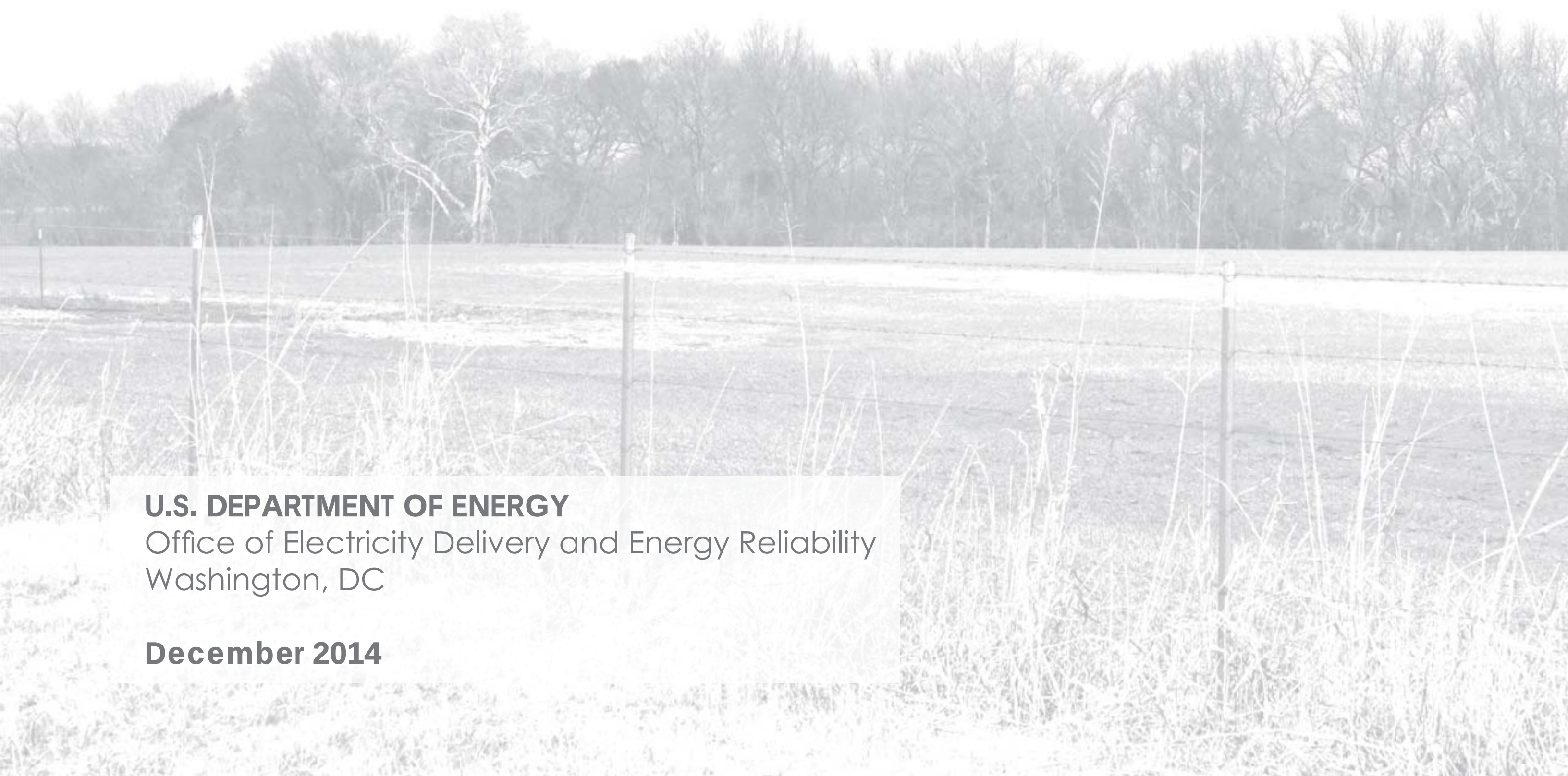
DOE/EIS-0486

Draft

PLAINS & EASTERN CLEAN LINE TRANSMISSION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Volume I of V



U.S. DEPARTMENT OF ENERGY
Office of Electricity Delivery and Energy Reliability
Washington, DC

December 2014

Department of Energy
Washington, DC 20585

Dear Reader:

Enclosed for your review and comment is the U.S. Department of Energy's (DOE's) Draft *Environmental Impact Statement for the Plains & Eastern Clean Line Transmission Line Project* (Draft EIS). Included with the Draft EIS is a Reference CD, which includes key Project-specific documents referenced in the Draft EIS (e.g., DOE Alternatives Development Report) as well as references cited in the Draft EIS that are not publicly available or protected under copyright law. DOE has prepared this Draft EIS in consultation with the following cooperating agencies: the Bureau of Indian Affairs, Natural Resources Conservation Service, Tennessee Valley Authority, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service.

In 2010, DOE, acting through the Southwestern Power Administration (Southwestern) and the Western Area Power Administration, both power marketing administrations within DOE, issued *Request for Proposals (RFP) for new or upgraded transmission line projects under Section 1222 of the Energy Policy Act of 2005* (75 *Federal Register* 32940; June 10, 2010). In response to the RFP, Clean Line Energy Partners LLC of Houston, Texas, the parent company of Plains and Eastern Clean Line LLC and Plains and Eastern Clean Line Oklahoma LLC (collectively referred to as Clean Line or the Applicant in the Draft EIS) submitted a proposal to DOE for the Plains & Eastern Clean Line Project (Applicant Proposed Project).

The Applicant Proposed Project would include an overhead ± 600-kilovolt (kV) high voltage direct current (HVDC) electric transmission system and associated facilities with the capacity to deliver approximately 3,500 megawatts primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to the Mid-South and Southeast United States via an interconnection with the Tennessee Valley Authority in Tennessee. Major facilities associated with the Applicant Proposed Project consist of converter stations in Oklahoma and Tennessee; an approximate 720-mile HVDC transmission line; an alternating current collection system; and access roads. The Draft EIS also analyzes potential environmental impacts of a No Action Alternative and several alternatives to the Applicant Proposed Project, including alternative routes for the HVDC transmission line and adding a converter station in Arkansas (to deliver power to the Arkansas electrical grid). The potential environmental impacts resulting from connected actions (wind energy generation and substation and transmission upgrades related to the Project) are also analyzed.

DOE's purpose and need for agency action is to implement Section 1222 of the Energy Policy Act of 2005. To that end, DOE needs to decide whether and under what conditions it would participate in the Applicant Proposed Project. DOE has not identified a preference for whether to participate with Clean Line in the Project in some manner as prescribed by Section 1222. DOE will identify its preference for whether to participate with Clean Line in the Applicant Proposed Project and its preferred alternatives for each of the Project elements (including route alternatives) in the Final EIS after evaluating public comments and agency input.

DOE invites interested parties to comment on the Draft EIS, as described below, during the 90-day comment period that will begin when the U.S. Environmental Protection Agency publishes a Notice of Availability of the Draft EIS in the *Federal Register*. DOE will publish a separate Notice of Availability in the *Federal Register* that provides the locations, dates, and times of the public hearings. This information also will be posted on the EIS website (http://www.plainsandeasterneis.com), and will be announced in the local news media.

DOE has also initiated consultation pursuant to Section 106 of the National Historic Preservation Act (NHPA) to consider the potential effects of the Project on historic properties. In addition to comments on the Draft EIS, DOE invites comments on the NHPA Section 106 process and any potential adverse impacts to historic properties from the Project. Comments may be made orally or in writing at a public hearing or may be submitted by any of the methods listed below. Written and oral comments will be given equal weight. Comments submitted after the close of the comment period will be considered to the extent practicable. Comments on the Draft EIS or Section 106 process may be submitted via the EIS website, by e-mail to comments@PlainsandEasternEIS.com, by fax at (303) 295–2818, or by mail. Comments submitted by mail should be sent to:

Plains & Eastern Clean Line EIS
216 16th Street, Suite 1500
Denver, Colorado 80202

Please mark envelopes and email and fax subject lines as "Plains & Eastern Draft EIS Comments." It is DOE's practice to make comments, including names and addresses of respondents, available for public review. Before including your address, phone number, email address, or other personal identifying information with your comments, be advised that your entire comment, including your personal identifying information, may be made publicly available at any time. Although you may ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. All submissions from organizations and businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, will be available for public inspection in their entirety.

For additional information, contact me at Jane.Summerson01@nnsa.doe.gov or visit the EIS website at: http://www.plainsandeasterneis.com.

Thank you for your interest and participation in the NEPA process.

Sincerely,

Jane Summerson, Ph.D.
NEPA Document Manager
on behalf of DOE’s Office of Electricity Delivery and Energy Reliability

COVER SHEET

RESPONSIBLE FEDERAL AGENCY: U.S. Department of Energy (DOE), Office of Electricity Delivery and Energy Reliability

COOPERATING AGENCIES: Natural Resources Conservation Service, Tennessee Valley Authority, U.S. Army Corps of Engineers, U.S. Bureau of Indian Affairs, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service

TITLE: Plains & Eastern Clean Line Transmission Line Project Draft Environmental Impact Statement (EIS) (DOE/EIS-0486)

LOCATION: Texas, Oklahoma, Arkansas, and Tennessee: counties in Texas—Hansford, Ochiltree, and Sherman; counties in Oklahoma—Beaver, Cimarron, Creek, Garfield, Harper, Kingfisher, Lincoln, Logan, Major, Muskogee, Okmulgee, Payne, Sequoyah, Texas, and Woodward; counties in Arkansas—Cleburne, Conway, Crawford, Cross, Faulkner, Franklin, Jackson, Johnson, Mississippi, Poinsett, Pope, Van Buren, and White; and counties in Tennessee—Shelby and Tipton.

CONTACTS: For additional information on this Draft EIS contact:

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For general information on the DOE NEPA process, please write or call:

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Leave a message at (800) 472-2756

ABSTRACT: In June 2010, DOE, acting through the Southwestern Power Administration and the Western Area Power Administration, both power marketing administrations within DOE, issued *Request for Proposals (RFP) for new or upgraded transmission line projects under Section 1222 of the Energy Policy Act of 2005* (EPAct; 42 United States Code [USC] 16421; 75 *Federal Register* 32940; June 10, 2010). In response to the RFP, Clean Line Energy

Partners LLC of Houston, Texas, the parent company of Plains and Eastern Clean Line LLC and Plains and Eastern Clean Line Oklahoma LLC (collectively referred to as Clean Line or the Applicant) submitted a proposal to DOE in July 2010 for the Plains & Eastern Clean Line Project. In August 2011, Clean Line modified the proposal. DOE is the lead federal agency for the preparation of this EIS (or Plains & Eastern EIS), which examines the potential environmental impacts from Clean Line's proposed Project (also referred to as the Applicant Proposed Project) and alternatives to it. DOE has prepared the EIS pursuant to NEPA (42 USC 4321 et seq.), the Council on Environmental Quality NEPA regulations (40 Code of Federal Regulations [CFR] Parts 1500 through 1508), and the DOE NEPA implementing regulations (10 CFR Part 1021). DOE's purpose and need for agency action is to implement Section 1222 of the EPAct. To that end, DOE needs to decide whether and under what conditions it would participate in the Applicant Proposed Project.

The Applicant Proposed Project would include an overhead ± 600-kilovolt (kV) high voltage direct current (HVDC) electric transmission system and associated facilities with the capacity to deliver approximately 3,500 megawatts primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to load-serving entities in the Mid-South and Southeast United States via an interconnection with the Tennessee Valley Authority electrical grid in Tennessee. Major facilities associated with the Applicant Proposed Project consist of converter stations in Oklahoma and Tennessee; an approximate 720-mile, ± 600kV HVDC transmission line; an alternating current collection system; and access roads. Pursuant to NEPA, DOE has identified and analyzed potential environmental impacts for several reasonable alternatives in addition to the Applicant Proposed Project. These alternatives include an Arkansas converter station and alternative routes for the HVDC transmission line.

DOE invites comments on this Draft EIS during the 90-day comment period that begins with the publication of the Notice of Availability in the *Federal Register* by the U.S. Environmental Protection Agency. DOE also invites comments on the Section 106 process and the potential adverse impacts to historic properties from the Project as described in the EIS. The EIS website (http://www.plainsandeasterneis.com) provides information on public hearings to be held at several locations during the comment period. Comments on the Draft EIS may be made orally or in writing at a public hearing or may be sent to the mailing address listed below, by email to comments@PlainsandEasternEIS.com, or by fax at (303) 295-2818.

Plains & Eastern Clean Line EIS
216 16th Street, Suite 1500
Denver, CO 80202

Written and oral comments will be given equal weight, and any comments submitted after the comment period ends will be considered to the extent practicable.

Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

Figures Presented in Appendix A

List of Appendices

Abbreviations and Acronyms

°C	Degrees Centigrade
°F	Degrees Fahrenheit
1/d2	One Divided by the Distance Squared
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACA	Arkansas Code Annotated
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACR	Alternative Capacity Requirement
ADEQ	Arkansas Department of Environmental Quality
ADTC	Average Daily Traffic Count
AGFC	Arkansas Game and Fish Commission
AGNIR	Advisory Group on Non-ionizing Radiation
AHTD	Arkansas State Highway and Transportation Department
AIRFA	American Indian Religious Freedom Act
ALL	Acute Lymphocytic Leukemia
AM	Amplitude Modulation
AMSL	Above Mean Sea Level
ANHC	Arkansas Natural Heritage Commission
ANRC	Arkansas Natural Resources Commission
APCEC	Arkansas Pollution Control and Ecology Commission
APE	Area of Potential Effects
APLIC	Avian Power Line Interaction Committee
APP	Avian Protection Plan
APR	Applicant Proposed Route
AQCE	Air Quality Control Regions
AR	Alternative Route
ARPA	Archaeological Resources Protection Act of 1979
ARRA	American Recovery and Reinvestment Act
AS	Antenna Structure
ASIS	Affected System Impact Studies
BG	Background
BGEPA	Bald and Golden Eagle Protection Act
BGS	Below Ground Surface
BIA	Bureau of Indian Affairs
BISON	Biodiversity Information Serving Our Nation
BLM	Bureau of Land Management

BLS	Bureau of Labor Statistics
BMP	Best Management Practice
BNSF	Burlington Northern Santa Fe Railway
BO	Biological Opinion
BPA	Bonneville Power Administration
BR	Biennial Report
CAA	Clean Air Act
CCN	Certificate of Public Convenience and Necessity
CEGT	CenterPoint Energy Gas Transmission Company
CENELEC	European Committee for Electrotechnical Standardization
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH4	Methane
CHAT	Crucial Habitat Assessment Tool
CIP	Critical Infrastructure Protection
CL	Centerline
cm	Centimeter
CM	Commercial Land Mobile
CMUP	Comprehensive Management and Land Use Plan
CO	Carbon monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CR	County Road
CRP	Conservation Reserve Program
CT	Cellular Tower
CUH NDB	Cushing Non-directional Radio Beacon
CZE NDB	Clarksville Non-directional Radio Beacon
dB	Decibels
dBA	A-weighted dB scale
dBµV/m	One-Millionth of a Volt Per Meter
DC	Direct Current
DEIS	Draft Environmental Impact Statement
DNR	Dedicated Neutral Return
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DPP	Definitive Planning Phase
eGRID	Emissions & Generation Resource Integrated Database
EIA	Energy Information Administration

EIS	Environmental Impact Statement
EMF	Electric And Magnetic Fields
EMI	Electro-Magnetic Interference
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPA Hazardous Waste Report BR	EPA Hazardous Waste Report Biennial Report
EPAct	Energy Policy Act of 2005
EPM	Environmental Protection Measure
EPRI	Electric Power Research Institute
ERS	Economic Research Service
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute, Inc.
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FDA	U.S. Food and Drug Administration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FFY	Federal Fiscal Year
FG	Foreground
FHWA	Federal Highway Administration
FLMPA	Federal Land Policy and Management Act of 1976
FM	Frqeuency Modulation
FPPA	Farmland Protection Policy Act
FR	Federal Register
FRA	Federal Railroad Administration
FRS	Facility Registry Service
FSA	Farm Service Agency
FT	Federally Threatened
FTA	Federal Transit Administration
FTE	Full-Time Equivalent
G	Gauss
g	Gravity
GCCRP	U.S. Global Climate Change Research Program
GHG	Greenhouse Gas
GHz	Gigahertz
GIS	Geographic Information System
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GRP	Grassland Reserve Program

HUC	Hydrologic Unit Code
HVDC	High-Voltage Direct Current
Hz	Hertz
I	Interstate
IARC	International Agency for Research on Cancer
IBA	Important Bird Areas
ICD	Implantable Cardioverter Defibrillators
ICES	International Committee on Electromagnetic Safety
ICIS	Integrated Compliance Information System
ICNIRP	International Committee on Non-Ionizing Radiation Protection
IEEE	Institute of Electrical and Electronics Engineers
IFR	Instrument Flight Rules
INV	Inventory Element
ions/cm^3	Ions per Cubic Centimeter
IPCC	Intergovernmental Panel on Climate Change
IS TEA	Intermodal Surface Transportation Efficiency Act of 1991
ISO	Independent System Operation
JEDI	Jobs and Economic Development Impact
Kf	K-factor
kHz	Kilohertz
KOP	Key Observation Point
KSDOT	Kansas Department of Transportation
kV	Kilovolt
kV/m	Kilovolts Per Meter
L_{dn}	Equivalent Day-Night Sound Level
LEPC	Lesser Prairie-Chicken
L_{eq}	Equivalent Sound Level
LESA	Land Evaluation and Site Assessment
L_{max}	Maximum Sound Level
LOS	Level of Service
LRMP	Land and Resource Management Plan
LUST	Leaking Underground Storage Tank
M	Magnitude
mA	Milliamps
MA	Management Area
MBTA	Migratory Bird Treaty Act
mG	milliGauss
MG	Middleground
MHz	Million Hertz

MIG NDB	Millington Non-directional Radio Beacon
MISO	Midcontinent Independent System Operator
MKO NDB	Muskogee Non-directional Radio Beacon
MLRA	Major Land Resource Area
mmBtu	One Million British Thermal Units
MOU	Memoranda of Understanding
MOVES	Motor Vehicle Emissions Simulator
mph	Miles per Hour
MPO	Metropolitan Planning Organization
MRDS	Mineral Resource Data System
MRI	Magnetic Resonance Imaging
MSA	Metropolitan Statistical Areas
MSDOT	Mississippi Department of Transportation
MSDS	Material Safety Data Sheet
MT	Microwave Tower
MW	Megawatt
MWh	megawatt hours
N_2O	Nitrogen Dioxide
N/A	Not Applicable
NAAQS	National Ambient Air Quality Standard
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NCDB	National Compliance Data Base
NDB	Non-Directional Beacons
NE	Not Evaluated
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NLCD	National Land Cover Dataset
NO	Nitrogen oxide
NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NO_x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places

NRI	Nationwide Rivers Inventory
NRIS	National Register Information System
NRPB	National Radiological Protection Board
NSA	Noise Sensitive Area
NSR	New Source Review
NTSB	National Transportation Safety Board
NTSC	National Television System Committee
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
O_3	Ozone
OAC	Oklahoma Administrative Code
OAS	Oklahoma Archaeological Survey
ODEQ	Oklahoma Department of Environmental Quality
ODWC	Oklahoma Department of Wildlife Conservation
OG&E	Oklahoma Gas & Electric
OHS	Oklahoma Historical Society
OKDOT	Oklahoma Department of Transportation
OKM VOR/DME	Standard Distance Measuring Equipment
OKSHPO	Oklahoma State Historic Preservation Office
ONHP	Oklahoma Natural Heritage Program
OPGW	Optical Ground Wire
ORV	Outstanding and Remarkable Values
OS	Oklahoma Statutes
OSHA	Occupational Safety and Health Administration
OWRB	Oklahoma Water Resources Board
PA	Programmatic Agreement
PCB	Polychlorinated Biphenyl
PDS	Permit Data Summary
PGA	Peak Ground Acceleration
PM	Private Land Mobile
PM_{10}	Particulate Matter Smaller than 10 Micrometers
$PM_{2.5}$	Particulate Matter Smaller than 2.5 Micrometers
PMA	Power Marketing Administration
ppb	Parts per Billion
ppm	Parts per Million
PR	Proposed Route
PSCo	Public Service Company
RCRA	Resource Conservation and Recovery Act
RCRAInfo	Resource Conservation and Recovery Act Information

RFP	Request for Proposal
RLRMP	Revised Land and Resources Management Plan
ROD	Record of Decision
ROI	Region of Influence
ROW	Right-of-Way
RTO	Regional Transmission Organization
RV	Recreational Vehicle
SARA	Superfund Amendments and Reauthorization Act of 1986
SE	State Endangered
SERC	SERC Reliability Corporation
SF_6	Sulfur Hexafluoride
SH	State Highway
SHPO	State Historic Preservation Officer
SIO	Scenery Integrity Objectives
SIP	State Implementation Plan
SIS	System Impact Study
SMS	Scenery Management System
SNR	Signal-to-Noise Ratio
SO_2	Sulfur Dioxide
SO_x	Oxides of Sulfur
Southwestern	Southwestern Power Administration
SPCCP	Spill Prevention, Control and Countermeasures Plan
SPP	Southwest Power Pool
SPS	Southwestern Public Service
SR	State Road
SSTS	Section Seven Tracking System
SSURGO	Soil Survey Geographic
ST	State Threatened
STAA	Short-Term Activity Authorization
SWANCC	Solid Waste Agency of Northern Cook County
SWCA	SWCA Environmental Consultants
SWPPP	Stormwater Pollution Prevention Plan
TCA	Tennessee Code Annotated
TCEQ	Texas Commission on Environmental Quality
TCP	Traditional Cultural Property
TDA	Tennessee Department of Agriculture
TDEC	Tennessee Department of Environment and Conservation
THPO	Tribal Historic Preservation Officers
TMDL	Total Maximum Daily Load

TNDOT	Tennessee Department of Transportation
TPWD	Texas Parks and Wildlife Department
TPY	Tons per Year
TRA	Tennessee Regulatory Authority
TRI	Toxics Release Inventory site
TV	Television
TVA	Tennessee Valley Authority
TVMP	Transmission Vegetation Management Plan
TWRA	Tennessee Wildlife Resources Agency
TX AC	Texas Administrative Code
TXDOT	Texas Department of Transportation
TX GC	Texas Government Code
TX H&SC	Texas Health and Safety Code
TX NRC	Texas Natural Resources Code
UHF	Ultra High Frequency
UKCCS	United Kingdom Childhood Cancer Study
UPRR	Union Pacific Railroad
URA	Uniform Relocation Act
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geologic Survey
VHF	Very High Frequency
V/m	Volts per Meter
VOC	Volatile Organic Compound
VOR	Very High Frequency Omnidirectional Range
VMT	Vehicle Miles Traveled
VRM	Visual Resource Management
WDZ	Wind Development Zones
WEG	Wind Erosion Group
Western	Western Area Power Administration
WHO	World Health Organization

WMA	Wildlife Management Area
WoUS	Waters of the United States
WRP	Wetlands Reserve Program
μV/m	One-Millionth of a Volt per Meter
$\mu g/m^3$	Micrograms per cubic meter

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Units of Measure

Common units of measure and conversion factors used in this report include:

Linear Measure

1 inch = 2.54 centimeters

1 foot = 0.3048 meter

1 yard = 0.9144 meter

1 mile = 1.6 kilometers

Area Measure

1 acre = 0.4047 hectare

1 square mile = 640 acres = 259 hectares

Capacity Measure (Liquid)

1 US gallon = 4 quarts = 3.785 liter

1 cubic meter per hour = 4.403 U.S. gallons per minute

From Socioeconomics

Jobs are full-time equivalents (FTEs) for a period of one year (1 FTE = 2,080 hours)

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Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

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1. Introduction

In June 2010, the U.S. Department of Energy (DOE), acting through the Southwestern Power Administration (Southwestern) and the Western Area Power Administration (Western), both power marketing administrations within DOE, issued *Request for Proposals (RFP) for new or upgraded transmission line projects under Section 1222 of the Energy Policy Act of 2005* (EPAct; 75 Federal Register [FR] 32940; June 10, 2010). In response to the DOE RFP, Clean Line Energy Partners LLC of Houston, Texas, the parent company of Plains and Eastern Clean Line LLC and Plains and Eastern Clean Line Oklahoma LLC (collectively referred to as Clean Line or the Applicant in this Environmental Impact Statement [EIS]) prepared a proposal (submitted in July 2010 and updated in August 2011) to develop new transmission facilities to be located in Oklahoma, Arkansas, Tennessee, and possibly Texas. Figures 1.0-1 and 1.0-2 (located in Appendix A) show topographic and aerial imagery of the Project.

Prior to making a decision as to whether and under what conditions to participate in Clean Line's proposed Plains & Eastern Project (the Applicant Proposed Project), DOE must fully evaluate the Project. This EIS will inform that decision. This chapter provides an overview of DOE's purpose and need for agency action, a description of requirements under Section 1222 of the EPAct, and Clean Line's goals and objectives as they relate to the Project. This chapter also includes a description of cooperating agencies and their roles, applicable federal agency regulations, and the environmental review process including a description of the National Environmental Policy Act (NEPA) process and stakeholder and agency involvement.

Commonly Used Terms

Throughout the Plains & Eastern EIS, the following terms are used to describe different elements of the proposal being evaluated.

Applicant Proposed Project—Based on Clean Line's modified proposal to DOE,[1] the basic elements include converter stations in Oklahoma and Tennessee, alternating current (AC) interconnections at each converter station, an AC collection system, and a high-voltage direct current (HVDC) transmission line from the Oklahoma Panhandle to western Tennessee. The Applicant Proposed Project is described in detail in Sections 2.1.2 through 2.1.7.

Proposed Action—For DOE to participate, acting through the Administrator of Southwestern, in the Applicant Proposed Project in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and possibly Texas,[2] but not Tennessee.

Applicant Proposed Route—The single 1,000-foot-wide route alternative defined by Clean Line to connect the converter station in the Oklahoma Panhandle to the converter station in western Tennessee. The analyses of impacts are typically based on a representative 200-foot-wide right-of-way (ROW) within the 1,000-foot corridor. The Applicant Proposed Route is described in detail in Section 2.4.2.

DOE Alternatives—Pursuant to NEPA, DOE has identified and analyzed potential environmental impacts for several reasonable alternatives in addition to the Applicant Proposed Project. These alternatives include an Arkansas converter station and alternative routes for the HVDC transmission line. In each instance, these alternatives have been discussed and evaluated with Clean Line for feasibility. The DOE Alternatives are described in detail in Section 2.4.3.

The Project—A broad term that generically refers to elements of the Applicant Proposed Project and/or DOE Alternatives when differentiation between the two is not necessary. The term also refers to whatever combination of project elements would be built if a decision is made by DOE to participate with Clean Line.

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1 In response to DOE's *Request for Proposals for New or Upgraded Transmission Line Projects under Section 1222 of the Energy Policy Act of 2005.*

2 Depending on AC collection system routes implemented (some of which are in Texas).

1.1 Department of Energy Purpose and Need

DOE is the lead federal agency for the preparation of the Plains & Eastern EIS. DOE has prepared this EIS pursuant to NEPA (42 United States Code [USC] § 4321; NEPA), the Council on Environmental Quality (CEQ) NEPA regulations (40 Code of Federal Regulations [CFR] Parts 1500 through 1508), and the DOE NEPA implementing regulations (10 CFR Part 1021). DOE's purpose and need for agency action is to implement Section 1222 of the EPAct. To that end, DOE needs to decide whether and under what conditions it would participate in the Applicant Proposed Project.

1.1.1 Section 1222 of the EPAct

Section 1222 of the EPAct, in relevant part, authorizes the Secretary of Energy, acting through and in consultation with the Administrator of Southwestern (provided the Secretary determines that certain statutory requirements have been met), to participate with other entities in designing, developing, constructing, operating, maintaining, or owning new electric power transmission facilities and related facilities located within any state in which Southwestern operates. Southwestern is one of four power marketing administrations that operate within DOE. Southwestern is chartered to market and deliver power to customers in the southwestern United States to rural electric cooperatives and municipal utilities, including Arkansas, Oklahoma, and Texas, with a preference to public bodies and cooperatives.

As mentioned above, Clean Line submitted a proposal and supporting information in response to DOE's RFP on July 6, 2010. Clean Line's original proposal included two high-voltage direct current (HVDC) lines, each rated at 3,500 megawatts (MW), and which together would have had the capacity to deliver 7,000MW. Subsequently in August 2011, Clean Line modified its proposal to a single HVDC line with the capacity to deliver 3,500MW (Clean Line 2011). DOE concluded that Clean Line's modified proposal complied with and was responsive to the RFP (DOE 2012).

The statutory criteria from Section 1222 (42 USC 16421) include:

1. The proposed project
    a. is located in an area designated under section 216(a) of the Federal Power Act (16 USC §824p(a)) and will reduce congestion of electric transmission in interstate commerce, or
    b. necessary to accommodate an actual or projected increase in demand for electric transmission capacity
2. is consistent with
    a. transmission needs identified, in a transmission expansion plan or otherwise, by the appropriate Transmission Organization (as defined in the Federal Power Act [16 USC 791a et seq.]), if any, or approved regional reliability organization, and
    b. efficient and reliable operation of the transmission grid
3. will be operated in conformance with prudent utility practice
4. will be operated by, or in conformance with the rules of, the appropriate Transmission Organization, if any, or if such an organization does not exist, regional reliability organization; and
5. will not duplicate the functions of existing transmission facilities or proposed facilities which are the subject of ongoing or approved siting and related permitting proceedings.

The decision whether to participate in a project is discretionary. In the June 2010 RFP, DOE explained that, in evaluating whether to participate in projects that have met the statutory eligibility criteria, DOE would also consider the following evaluation criteria that are not explicitly set forth in the statute:

1. Whether the project would be in the public interest
2. Whether the project would facilitate the reliable delivery of power generated by renewable resources
3. The benefits and impacts of the project in each state it traverses, including economic and environmental factors
4. The technical viability of the project, considering engineering, electrical, and geographic factors
5. The financial viability of the project

The purpose of the Plains & Eastern EIS is to evaluate the potential environmental impacts from the Applicant Proposed Project and several reasonable alternatives that also meet the purpose and need to implement Section 1222 of the EPAct and a “No Action” alternative. Potential environmental impacts are one of several factors that DOE will consider when deciding whether to participate in the Applicant Proposed Project.

The Plains & Eastern EIS analyzes the potential environmental impacts of the entire Project. This ensures that any decision by DOE or another agency is fully informed. DOE may decide to participate in any or all of the states in which Southwestern operates, namely Oklahoma, Arkansas, and Texas. However, DOE would not participate in the Project in Tennessee because that state is outside Southwestern’s operational area. Other agencies, federal or state, may have jurisdiction over parts of the Project that are located in Tennessee. Some of these agencies could include, but not be limited to, Tennessee Valley Authority (TVA), U.S. Army Corps of Engineers (USACE), and Tennessee state agencies.

1.2 Cooperating Agencies

DOE is the lead agency for the preparation of the Plains & Eastern EIS. As lead agency, DOE retains overall responsibility for the NEPA process, including the Draft and Final EIS and DOE’s Record of Decision (ROD), if any. DOE’s responsibilities include determining the purpose and need for DOE’s agency action, identifying for analysis the range of reasonable alternatives to its Proposed Action, identifying potential environmental impacts of the Proposed Action and reasonable alternatives, identifying its preferred alternative, and determining appropriate mitigation measures.

DOE is also the lead agency for consultation required under Section 106 of the National Historic Preservation Act (NHPA), 16 USC § 470. DOE is using the NEPA process and documentation required for the Plains & Eastern EIS to comply with Section 106 of the NHPA in lieu of the procedures set forth in Sections 800.3 through 800.6 of the NHPA. This approach is consistent with the recommendations set forth in the NHPA implementing regulations that Section 106 compliance should be coordinated with actions taken to meet NEPA requirements (36 CFR 800.8(a)(1)). Additional information regarding compliance with Section 106 of the NHPA is provided in Section 3.9.

In addition to DOE acting as the lead agency for the Plains & Eastern EIS, several other agencies are participating as cooperating agencies as described in 40 CFR 1501.6. These cooperating agencies have also participated, along with other federal and state agencies, in routing and siting activities related to their jurisdiction, authority, or expertise (Section 1.6). Appendix B contains copies of primary correspondence between DOE and these agencies.

The cooperating agencies for the Plains & Eastern EIS are identified in Table 1.2-1.

Table 1.2-1:
Plains & Eastern EIS Cooperating Agencies

Cooperating Agencies
Bureau of Indian Affairs (BIA)
Natural Resources Conservation Service (NRCS)
Tennessee Valley Authority (TVA)
U.S. Army Corps of Engineers (USACE)
U.S. Environmental Protection Agency (EPA) Regions 4 and 6
U.S. Fish and Wildlife Service (USFWS)

Also, DOE has invited federal, state, tribal government, and local agencies with jurisdiction by law and/or with special expertise applicable to the Proposed Action to consult under Section 106 of the NHPA pursuant to 36 CFR 800.2(c).

The following sections provide information regarding each cooperating agency. The sections include a description of the agency and its responsibilities, the basis for participation as a cooperating agency, and the extent to which the agency will rely on the Plains & Eastern EIS to fulfill its obligations under NEPA or related laws.

1.2.1 Bureau of Indian Affairs

The BIA is a bureau within the Department of the Interior responsible for the administration and management of land held in trust for American Indians and federally recognized Tribes. The BIA is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Rights-of-Way over Indian Lands (25 CFR Part 169)
- Potential impacts to Traditional Cultural Properties (TCPs; NHPA Section 101(d)(6))

The BIA will, to the extent permitted by law, rely on the environmental analyses and Section 106 consultation developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA and Section 106 of the NHPA for any action, permit, or approval by the BIA for the Project.

1.2.2 Natural Resources Conservation Service

NRCS is a federal agency within the Department of Agriculture whose mission is to provide national leadership in the conservation of soil, water, and related natural resources. The NRCS provides balanced technical assistance and cooperative conservation programs to landowners and land managers throughout the United States. NRCS is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Farmland Protection Policy Act (7 USC § 4201 et seq.; 7 CFR Part 658)
- Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended (16 USC 1001–1009)
- Wetland Reserve Program (16 USC § 3837 et seq.)
- Grassland Reserve Program (16 USC § 3838N-3838q.)
- Healthy Forests Restoration Act of 2003, Public Law 108–148 (16 USC § 6501 et seq.)
- The 1996 U.S. Farm Bill, Public Law 104–127 (110 Stat. 888–1197)

The NRCS will, to the extent permitted by law, rely on the environmental analyses developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA for any action, permit or approval by the NRCS for the Project.

1.2.3 Tennessee Valley Authority

TVA is a federally owned corporation that provides electricity to about 9 million people in parts of seven southeastern states. TVA is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law by virtue of the approvals that would need to be obtained from TVA before interconnecting the Project to the transmission system TVA operates in the Tennessee Valley region. TVA has extensive experience in the planning, construction, and operation of electrical transmission lines and substations. As a federal agency, TVA is also recognized as having special expertise in assessing, under NEPA, the potential environmental impacts of federal projects undertaken in the Tennessee Valley region, including electricity transmission systems and related facilities.

TVA will, to the extent permitted by law, rely on the environmental analyses and Section 106 consultation developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA and Section 106 of the NHPA for any action, permit, or approval by TVA for the Project.

TVA's purpose and need for agency action is to respond to Clean Line's request to interconnect the Project to the TVA transmission system. In response to the interconnection request, TVA conducted studies that indicate certain upgrades are needed to the TVA transmission system to maintain system reliability (TVA 2014). TVA therefore has the additional purpose and need of making the upgrades to its transmission system that would be necessary to interconnect with the Project while maintaining reliable service to its customers. TVA anticipates tiering from this EIS when completing its review of potential environmental impacts of upgrades to its transmission system as required by NEPA.

1.2.4 U.S. Army Corps of Engineers

The USACE is a federal agency within the Department of Defense. The USACE is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Section 404 of the Clean Water Act (33 USC § 1344)
- Section 10 of the Rivers and Harbors Act of 1899 (33 USC 401 et seq. and 33 USC § 408 et seq.)

Authorization from the USACE is required for features of the Project that cross over, through, or under navigable waters as defined under Section 10 of the Rivers and Harbors Act of 1899. Authorization from the USACE is also required for any activity that would result in discharges of dredged or fill material into waters of the United States as defined in Section 404 of the Clean Water Act. If granted, the USACE authorization would be issued in the form of a permit verification.

In addition to responsibilities identified above, the USACE may also be responsible for approving work that might affect federal projects as required by 33 USC § 408. These include federal projects such as the levees found along the Mississippi River and could include work within 1,500 feet outward from the toe of either side of a levee.[3]

Permits and permit verifications would be necessary from the USACE for portions of the Project (including areas within the state of Tennessee). As a cooperating agency, the USACE will review on the route alternatives contained in the Plains & Eastern EIS. The USACE may consider the routing alternatives in Tennessee as presented in this EIS when making its permit decisions and will use the analysis contained in this EIS to inform all of its permit decisions for the Project. The USACE could, to the extent permitted by law, rely on the environmental analyses and Section 106 consultation developed through this NEPA process and resulting EIS to fulfill its obligations under NEPA and Section 106 of the NHPA for any action, permit, or approval by the USACE for the Project.

1.2.5 U.S. Environmental Protection Agency

EPA is a federal agency that was created in 1970 for the purpose of protecting human health and the environment. EPA has ten regional offices, each of which is responsible for execution of their program. Region 4 (Southeast) includes the state of Tennessee. Region 6 (South-Central) includes the other states potentially involved in the Project (Arkansas, Oklahoma, and Texas). The EPA (Regions 4 and 6) is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Environmental laws
- Executive Orders dealing with environmental review of actions
- NEPA assessment and procedures

In addition, under Section 309 of the Clean Air Act, the EPA is required to review and publicly comment on the environmental effects of major federal actions, including actions that are the subject of EIS documents. If the EPA determines that the action is environmentally unsatisfactory (per the Section 309 criteria), it is required by Section 309 to refer the matter to the CEQ.

1.2.6 U.S. Fish and Wildlife Service

USFWS is a bureau within the Department of the Interior whose mission is to conserve, protect, and enhance fish, wildlife, and plants and their natural habitats for the continuing benefit of the American people. USFWS is a cooperating agency in the preparation of the Plains & Eastern EIS and is recognized to have jurisdiction by law and/or has special expertise in the following areas:

- Endangered Species Act (16 USC § 1531 et seq.)
- Migratory Bird Treaty Act (16 USC § 703 et seq.)
- Bald and Golden Eagle Protection Act (16 USC § 668 et seq.)
- The National Wildlife Refuge System Administration Act (16 USC § 668dd–68ee)
- Executive Order 13186 and DOE and USFWS Memorandum of Understanding (DOE and USFWS 2013)

[3] The toe of a levee is the outer edge of the levee base where the levee meets the levee grade.

The USFWS will, to the extent permitted by law, rely on the environmental analyses developed through this NEPA process and resulting Plains & Eastern EIS to fulfill its obligations under NEPA for any action, permit, or approval by the USFWS for the Project.

1.3 Other Federal Agency Involvement

This section describes the potential roles and responsibilities of additional federal agencies other than those identified above as cooperating agencies. Additionally, Appendix C presents an overview of potential federal and state permits and consultation that could be required for construction of the Project.

1.3.1 Advisory Council on Historic Preservation

The Advisory Council on Historic Preservation (ACHP), in accordance with 36 CFR 800.2(b), issues regulations to implement Section 106 of the NHPA, and provides guidance, advises, and generally oversees operation of the Section 106 process. Section 106 of the NHPA requires federal agencies to consider effects of federal undertakings on historic properties. Historic properties include those on the National Register of Historic Places (NRHP) or that meet the criteria for the National Register (ACHP 2013). DOE informed the ACHP and the State Historic Preservation Officers (SHPOs) of Oklahoma, Texas, Arkansas, and Tennessee by letter of DOE's intent to use the NEPA process and documentation required for the Plains & Eastern EIS to comply with Section 106 of NHPA in lieu of the procedures set forth in Sections 800.3 through 800.6 of the NHPA. The ACHP has been consulting with DOE on various topics, including the potential programmatic agreement as part of the Section 106 consultation.

1.3.2 National Park Service

The National Park Service (NPS) is a bureau of the Department of the Interior and would be responsible for issuing ROW permits if the Project crosses land managed by the NPS per 16 USC § 79. Portions of the congressionally designated Trail of Tears National Historic Trail are under the managing jurisdiction of the NPS. The Project route alternatives would cross segments of the Trail; however, neither the Applicant Proposed Route nor the DOE alternative routes cross any portions managed by the NPS. DOE has provided the NPS with the location data for each of the route alternatives. The NPS is also participating as a consulting party under Section 106.

1.3.3 U.S. Department of Transportation, Federal Highway Administration

The Federal Highway Administration (FHWA) is an agency within the U.S. Department of Transportation (DOT) that would be responsible for issuing encroachment permits if the Project crosses federally funded highways.

1.3.4 U.S. Forest Service

The U.S. Forest Service (USFS) is a federal agency within the Department of Agriculture that manages Ozark-St. Francis National Forests (Forests). The Forests has a Revised Land and Resources Management Plan (RLRMP) developed in 2005 with public input that provides direction for its management (USFS 2005). An HVDC alternative route (HVDC Alternative Route 4-B) that would cross the Ozark National Forest was proposed as a result of public scoping comments and analyzed in the Plains & Eastern EIS. DOE has consulted with the USFS regarding this alternative route.

1.4 Clean Line's Goals and Objectives

According to Clean Line's proposal prepared in response to the DOE *Request for Proposals for New or Upgraded Transmission Line Projects under Section 1222 of the Energy Policy Act of 2005* (submitted in July 2010 and modified in August 2011), Clean Line proposes to develop new transmission facilities to be located in Oklahoma, Arkansas, Tennessee, and possibly Texas. According to Clean Line's proposal, "The Plains and Eastern Clean Line is necessary to accommodate the actual and projected increase in demand for additional electric transmission capacity to deliver renewable energy from western SPP to load centers in the southeastern United States." Further, Clean Line's stated objectives for development of the Applicant Proposed Project include:

- Improving public access to renewable energy at a competitive cost by facilitating the transfer of available wind energy in the Oklahoma and Texas Panhandle regions to areas with increasing demands
- Providing an efficient and reliable interconnection between the Southwest Power Pool (SPP) and TVA that facilitates the transfer of 3,500MW of wind generated electricity and is consistent with applicable transmission system plans
- Assisting in satisfying the growing customer demand for renewable energy
- Providing safe, efficient and reliable transmission infrastructure consistent with prudent utility practice

1.5 National Environmental Policy Act

Major federal actions that may significantly affect the quality of the human environment require preparation of an EIS to comply with NEPA. NEPA requires that all federal agencies consider the potential environmental impacts of their proposed actions. Under NEPA, the term environment encompasses both the physical environment (e.g., air, water, geography, geology) and the human environment (e.g., health and safety, jobs, housing, schools, transportation, cultural resources).

1.5.1 NEPA Process

The CEQ established NEPA regulations for all federal agencies, including procedures for preparing EIS documents (40 CFR Parts 1500 through 1508). Individual agencies, including DOE, have established their own implementing procedures to supplement and use in conjunction with these requirements (10 CFR Part 1021). The major steps in the NEPA process for preparing an EIS are issuing a Notice of Intent (NOI) to prepare an EIS; gathering input on the scope of the EIS from federal, state, and local agencies, tribal governments, the public, and other stakeholders; preparing the Draft EIS; receiving public comments on the Draft EIS; preparing an Final EIS, including responses to comments received on the Draft EIS; and issuing a ROD. Each of these steps is discussed below and Figure 1.5-1 illustrates the process.

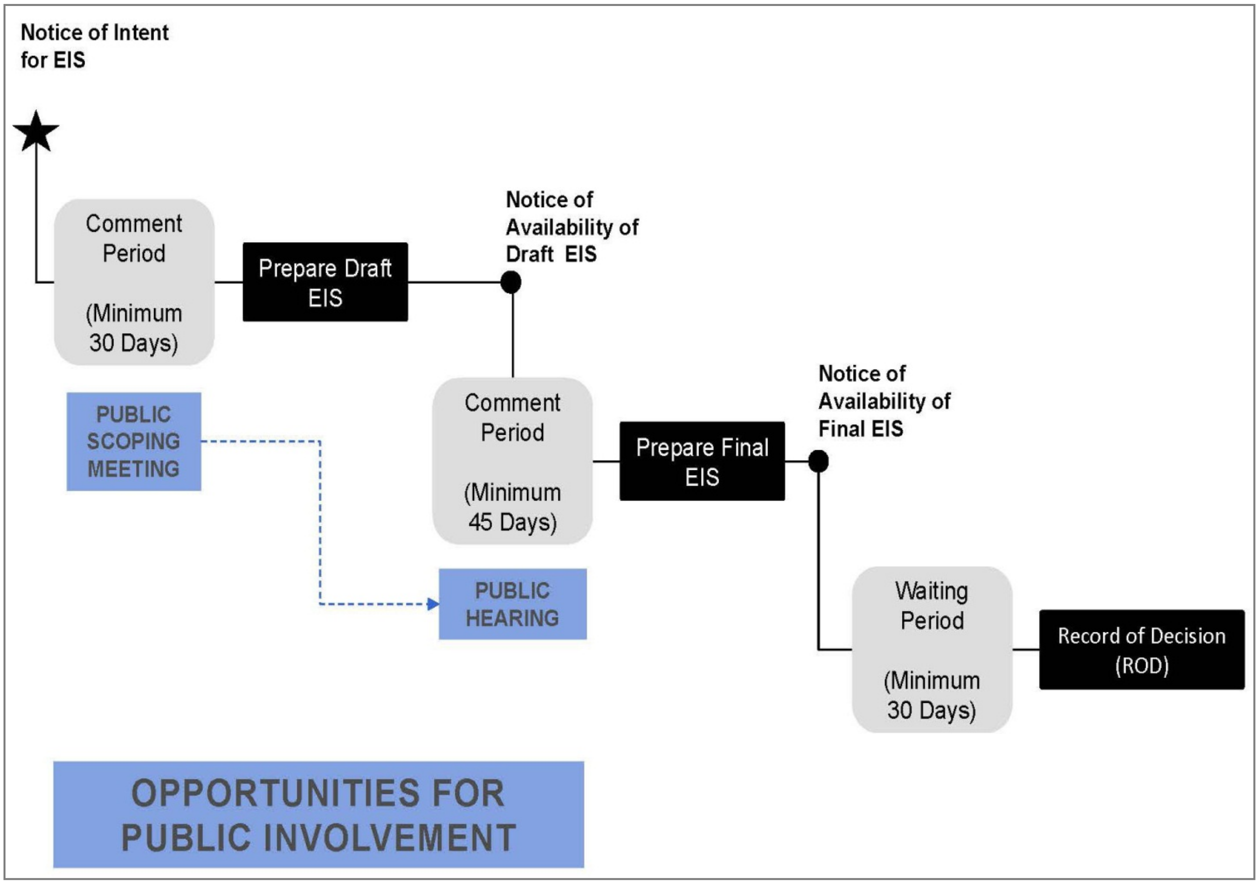

Figure 1.5-1: The EIS Process

1.5.2 Public Scoping

The public scoping period for the Project began with DOE's publication of the NOI on December 21, 2012. The NOI is included in Appendix D. The public scoping period continued for ninety days through March 21, 2013. DOE held thirteen public scoping meetings in communities along the proposed and alternative routes and five interagency meetings during the scoping period. The purpose of scoping was for DOE to request and receive comments on the scope of the EIS and alternatives from the public, agencies, tribes, and other interested parties. At the public and agency scoping meetings, DOE presented large-scale maps (42 inches by 60 inches) of the potential project area to gather input on the potential transmission line routing. These maps are shown in Appendix E of the DOE Alternatives Development Report (DOE 2013). (The DOE Alternatives Development Report is discussed in more detail in Section 2.3 of the Plains & Eastern EIS.) The Native American tribes and federal, state, and local agencies contacted during public scoping are addressed in Section 1.6.

DOE received 664 scoping comment documents; many of which included multiple scoping comments. DOE reviewed all scoping comments and prepared a Scoping Summary Report (Appendix E). Comments pertaining to potential Project locations were categorized and compiled by location in a spreadsheet shown in Appendix F of the DOE

Alternatives Development Report (DOE 2013). Issues that were identified during scoping are categorized by environmental resource area and presented in Table 1.5-1.

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Accidents, Intentional Destructive Acts, and Hazards (including air space)	
Analyze impacts of aircraft operating in the area of the transmission lines, specifically associated with aerial application of pesticides and fertilizers (Segment L-3, Jackson and Poinsett counties, Arkansas).[1]	Section 3.8
Avoid locating the line in areas near personal airstrips and small airports.	Section 3.8
Consider impacts of tornadoes, fire, earthquake, snow, and ice storms. Discuss the liability and responsibility to maintain the line and ROW in the event of an accident caused by such events.	Section 3.8
Agriculture	
Analyze effects of Project on agricultural operations, water management systems (e.g., surface water reservoirs, underground oil and gas pipelines, and tail-water recovery systems), irrigation and/or drainage systems (specifically the use of two center pivot irrigation systems), removal/damage of acreage, seeding, impacts on planting and harvesting, crop production, and aerial applications of fertilizer, insecticide, and herbicide.	Section 3.2
Analyze potential impacts of Project on precision-graded rice and farm fields (Regions 5, 6, and 7).[1]	Section 3.2
Describe and consider impacts to rice production and indirect impacts on migrating waterfowl that rely on rice producing lands for feeding and winter habitat.	Section 3.2
Analyze how loss of land may reduce area for grazing and hay production.	Section 3.2
Air Quality and Climate Change	
Analyze the impacts on air quality and climate change once the Project is completed. Compare and contrast these impacts with the impacts of various other resources (renewable and non-renewable) that could be used to produce and transmit power.	Section 3.3
Consider impacts on climate change associated with destruction of trees.	Section 3.3
Alternatives—General	
Opposition to the Project being built across areas/states that will receive no benefit from it, specifically Arkansas and Oklahoma; Project should be built in the areas that will receive the electricity needed/produced.	Section 2.4
Update and revise location of gas pipelines and electric transmission lines, including new Oklahoma Gas & Electric (OG&E) transmission lines.	Chapter 4; Figures 4.2-1a through 4.2-1f (located in Appendix A)
Identify locations of oil/gas wells within proximity to route corridors.	Section 3.6
Route along field/property lines and avoid bisecting properties and fields.	Section 2.3
Identify additional/missing homes on maps showing the network of potential routes.	Section 2.3
Identify location of springs used to water livestock and farms.	Section 3.15
Follow ROWs (highways, interstates, other lines/oil and gas pipelines/utilities).	Section 2.3
Bury the proposed transmission line.	Section 2.4
Consider other alternatives such as hydroelectric (dam), nuclear, solar, or Atlantic seaboard-based wind farms.	Section 2.4
Avoid populated areas.	Section 2.3
Avoid routes that cross cemeteries.	Section 2.3
Place line on government/public lands.	Section 2.3
Avoid National Audubon Society Important Bird Areas.	Section 3.20
Avoid conservation areas on public and private lands.	Section 2.3
Avoid public lands.	Section 2.3
Commenters requested implementation timeline, Gantt charts detailing resources and critical path, and information about phone lines in Pope County, Arkansas.	Appendix F (Section 3.2 and Appendix C)

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Commenters requested information about cost of project and the cost to federal government.	Section 3.13
Commenters requested information about use of solar panels with HVDC for better efficiency and production of electricity.	Section 2.4
Connected Actions	
Analyze impacts of wind farms that will be constructed in conjunction with the Project.	Chapters 3 and 4
Address responsibility for removal of turbines and towers in the event the Project is terminated at some point in the future.	Chapter 3
Cultural, Historic, and Archaeological Resources	
Analyze impacts to cultural, historical, and archaeological resources, including Native American relics and artifacts (Segments K and L), burial sites; family cemeteries (Segment C and M-5); historic sites, including Butterfield Trail Stage Route, the Trail of Tears, and area battlefields, and routes connecting to those sites (Segment G); Sheridan's Roost; Sequoyah Home Museum and other Cherokee heritage sites; and other cultural activities and sites along the proposed route.[1]	Section 3.9
Consider impacts on cultural values of landowners and residents of remote areas, including the impact on future generations who may wish to reside on or farm their families' ancestral properties.	Section 3.9
Analyze impacts to "Centennial" farms and trees in Oklahoma.	Section 3.9
Cumulative Impacts	
Analyze cumulative impacts of wind farms associated with the Project.	Chapter 4
Discuss impacts of potential future projects that may be located near the Project.	Chapter 4
Analyze cumulative impacts on agriculture, wildlife, aesthetic and scenic values, and the economy and the culture of areas that would be impacted by the Project.	Chapter 4
Address cumulative impacts of past, current, or future, local, state, and/or federal projects.	Chapter 4
Address impacts of the construction of Interstate 69 in and around Munford, Tennessee (Segment M-4).[1]	Chapter 4
Electric and Magnetic Fields	
Analyze health impacts of high-voltage transmission lines to humans, livestock, and plants.	Section 3.4
Address impacts of electric and magnetic fields (EMF) on Global Positioning System (GPS), cell phones, medical devices, television, and internet.	Section 3.4
Discuss potential for stray voltage and how structures are grounded.	Section 3.4
Environmental Justice	
Consider environmental justice implications in the use of private land for private gain, specifically percentage of landowners that rely on income from the land that could be devalued by construction of the transmission line.	Sections 3.5 and 3.13
Geology and Soils (including minerals)	
Analyze impacts of construction equipment and installation of towers and power lines on erosion, scouring, silting, (Segment G).[1]	Section 3.6
Address erosion control activities on the ROW, specifically in hilly areas where removal of trees will cause impacts on Federal Scenic Waterways.	Section 3.6
Analyze impacts of Project to rice production/irrigated agriculture, specifically clay hardpan. Consider that soil structure is crucial to these activities and damage to hardpan will cause loss of topsoil and loss of productivity.	Section 3.2
Consider features such as rough terrain, buffalo wallows, fault lines (Mulberry Fault), and steep-sided hills.	Section 3.2 and 3.6
Human Health and Safety	
Analyze impacts of high-voltage transmission lines on health of humans, especially the young and elderly, as well as livestock (Segments C, F-8, G-3, K, L, and M-4).[1]	Section 3.4
Discuss health impacts of high-voltage transmission lines on GPS, pacemakers, farm equipment, defibrillators, neurostimulators, and medical equipment.	Section 3.4

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Analyze potential for the Project to cause faulty GPS signals that may cause GPS-guided aircraft and or farm equipment to collide with structures and wires erected.	Section 3.4
Address health impacts of the Project resulting from grass/wild fires, structures or towers that fail, and electrocution due to downed lines.	Section 3.4
Analyze impacts on water quality of a drinking water supply (Segment G-3, under the EPA and Arkansas Department of Health's Source Water Protection Program).[1]	Section 3.15
Land Acquisition and Land Rights	
Describe the potential use of eminent domain or other land easements to obtain private property.	Section 2.1.3
Discuss how ROW access may invite trespassing on private property.	Appendix F (EPM GE-8)
Describe how construction and maintenance debris will be removed from private property.	Appendix F (Section 3.2.8)
Analyze how the Project may negatively impact the ability for small oil/gas producers to lease property for oil and natural gas exploration and production.	Section 3.6
Discuss whether access to lands would also provide access to mineral rights below the surface for fracking.	Section 2.1
Evaluate utilizing existing levee system, easements, or ROWs.	Section 2.3
Land Use	
Discuss impacts on future oil and gas drilling activities	Section 3.6
Discuss the restrictions the Project will place on future land use (public and private) and cultivation/development.	Section 3.10
Discuss possibility that Project may impair or delay conservation efforts and agreements, impacts to status of federally designated areas, including Blueway (water trail), scenic byway, and wildlife refuge designations.	Sections 3.12 and 3.15
Mitigation	
Consider mitigation needs in areas where wetland mitigation banks do not exist.	Section 3.19
Address use of best management practices (BMPs) for construction to mitigate impacts to wildlife habitat, including sensitive species and species of concern.	Sections 3.14 and 3.20
Discuss plans to prevent soil erosion during and after construction, including responsibility for long-term effects of erosion, sediment in streams, and duration of responsibility.	Section 3.6
NEPA Process	
The NEPA process should be held in abeyance until there is a full and fair hearing on the merits of Clean Line's application [under Section 1222].	Section 1.1
Individuals received notification of scoping meetings with too short notice or after meetings in their area had been held.	Appendix E
Requests for extension of scoping period.	Appendix E
Continue the level of public involvement during public hearings on Draft EIS. Commenter suggested that Clean Line has been very open with level of information and interaction with public.	Appendix E
Commenters expressed dissatisfaction with lack of communication about the Project and the quality of the maps at the scoping meetings and on the EIS website.	Appendix E
Address concerns that Northern route (Segment M-4) was announced during scoping period.[1]	Appendix E
Comments should have been recorded during scoping meetings.	Appendix E
Petitions	
A petition was submitted by residents of Cedarville, Arkansas, and Crawford County, Arkansas, who are against the power transmission line coming through the county (Segment G). Four hundred eleven people signed the petition. Specific comments were identified in the petition and were included in the summaries for the following topics discussed above: route-specific alternatives, socioeconomic, agriculture, and cultural, historical, and archaeological resources.[1]	Appendix E

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Purpose and Need	
The federal government should not be involved in the Project, because the Project would benefit a private corporation.	Chapter 1
Recreation	
Analyze impacts on recreational uses including fishing, hunting, hiking, camping, canoeing (Lake Poinsett; Poinsett County, Arkansas; Segment K-1 Jackson County, Arkansas).[1]	Section 3.12
Consider impacts on recreational areas, including national and state parks and forests.	Section 3.12
Consider disturbance of recreational activities such as hang-gliding or riding all-terrain vehicles on private lands.	Section 3.12
Avoid crossings of resources that are Scenic Byways, Extraordinary Resource Waters, or National Blueways, in areas that may have recreational importance. [A National Blueway designation includes the entire river from its "headwaters to mouth" as well as the river's watershed (American Rivers 2014).]	Section 3.12
Address use of easement areas for recreational activities such as hiking and camping.	Section 3.12
Socioeconomic Resources	
Evaluate and quantify expected impacts on property and land values along the route.	Section 3.13
Address compensation of land owners along the proposed ROW.	Section 3.13
Describe the economic benefits of the Project to the residents and state of Arkansas.	Section 3.13
Analyze the direct and indirect economic impacts of the proposed route, including to industries such as agriculture, tourism, rice farmers, duck hunting operations (Segments L, L-2, and L-4), and timber farmers.[1]	Section 3.13
Analyze impacts of short and long-term employment associated with the Project.	Section 3.13
Discuss the impacts of the Project on plans for future development and mineral exploration opportunities.	Section 3.13
Discuss how much the Project will cost the state of Tennessee.	Section 3.13
Discuss the impacts of the Project on smaller communities within the Project area that may not be able to absorb the influx of population.	Section 3.13
Traffic and Noise	
Analyze noise emitted by power lines.	Section 3.4
Consider impacts of noise caused by ROW crews, including the possibility for extended work hours.	Section 3.11
Consider impacts of increased traffic from construction and maintenance, including increase in dangerous conditions and damage to roads.	Sections 3.11 and 3.16
Address road improvements that will be made before, and after, construction of the Project (Segment H; Woodward, Oklahoma).[1]	Section 3.16, Chapter 4
Vegetation	
Identify and address use of BMPs to minimize disturbance to natural resources, including ground cover, hay production, pecan groves, and sensitive plants along the entire route.	Sections 3.2, 3.10, and 3.17
Address potential impacts that removal of vegetation would have on impaired water bodies, specifically related to filtering of pollutants.	Sections 3.15 and 3.17
Describe impacts of Project on significant grassland habitat in central Oklahoma (Segment F-8).[1]	Section 3.17
Discuss how vegetation will be managed along the ROW, specifically the use of chemicals and ability of landowners to manage vegetation as they desire (i.e., without the use of herbicides and defoliants).	Sections 3.8 and 3.17
Visual and Aesthetic	
Quantify and evaluate the visual impacts of the Project, including on scenic vistas.	Section 3.18
Describe the impacts to property owners' views that may be impacted by the proposed route.	Section 3.18
Avoid crossings/routes in Arkansas in areas that negatively impact scenic sections of Extraordinary Resource Waters; high quality fisheries; Arkansas Water trails; Arkansas Heritage Trails; and National Blueways; and National Scenic Byways.	Section 3.18

Table 1.5-1:
Issues Identified through Scoping

Resource or Issue Area and Issues to be Analyzed	Location in EIS
Analyze how the visual impacts of the Project may have negative effects on tourism and recreational activities.	Section 3.18
Discuss design aspects of the Project, including tower structures and distance between towers.	Section 3.18
Discuss impacts created by light pollution.	Section 3.18
Waste Management	
No scoping comments were received in this category.	
Water Resources	
Analyze impacts to water resources including water quality, pollutant sources, load allocations associated with drinking water standards, drinking water sources, wells, springs, wetlands, alluvial aquifers, rivers, streams, creeks, and lakes.	Section 3.15
Discuss impacts to floodplains.	Section 3.19
Discuss impacts to several sensitive, designated, and navigable resources being crossed or in the vicinity of the Project (Segments J, L-4, L-5, and M-5).[1]	Sections 3.15 and 3.19
Discuss impacts to aquifers, specifically in Jackson and Poinsett counties where alluvial aquifer begins at 15 feet below the surface.	Section 3.15
Discuss mitigation measures to protect underground water and water wells.	Section 3.15
Wildlife (including fish and critical habitat)	
Discuss potential for the Project to cause fragmentation of wildlife habitat, including to significant grassland habitat in central Oklahoma.	Sections 3.14 and 3.20
Address the impact to threatened and endangered species, and their habitat, found along the proposed routes, including mitigation and plans to avoid sensitive species.	Section 3.14
Analyze impacts of the Project on migratory bird habitat and flyways (including Mississippi Flyway).	Sections 3.14 and 3.20
Discuss impacts of Project on migrating birds.	Sections 3.14 and 3.20
Proposed routes should avoid lands recognized by the National Audubon Society as Important Bird Areas.	Section 3.20
The route that includes Cedarville, Arkansas, will impact the Ozark Mountains habitat currently protected by a partnership with the U.S. Geological Survey and the Arkansas Natural Heritage Commission.	Sections 1.5 and 2.5
Discuss impacts to old growth forests and the American burying beetle (Segment J).[1]	Sections 3.4 and 4.3
Describe potential impacts to the Cache River National Wildlife Refuge.	Sections 3.10, 3.12, 3.18, 3.20
Discuss impacts to the lesser prairie-chicken.	Sections 3.14 and 4.3

1 Segment identifications are based on the segment letters and numbers for the network of potential routes provided during public scoping (See Appendix E of the Alternatives Development Report (DOE 2013) for more information).

Several comments received during the scoping period identified the lack of benefits from the Applicant Proposed Project to residents in Arkansas (e.g., ability to accept increased amounts of renewable energy, tax revenues from property and ad valorum taxes associated with new facilities, and increased number of jobs). As a result of these scoping comments, DOE requested that Clean Line evaluate the feasibility of an alternative that would add a converter station in Arkansas in order to facilitate the delivery of up to 500MW of electricity to the state. The DOE Alternatives evaluated in the Plains & Eastern EIS include a converter station alternative in Arkansas. The details of this converter station alternative are presented in Chapter 2 (Sections 2.1.2.1 and 2.4.3.1).

The development of route alternatives considered the numerous scoping comments on the topic of transmission line routing. The details of the route selection process are provided in Sections 2.3 and 2.4 of the Plains & Eastern EIS and in the DOE Alternatives Development Report (DOE 2013).

1.5.3 Draft Environmental Impact Statement

This Draft EIS analyzes and compares the potential environmental impacts of the Applicant Proposed Project, the range of reasonable alternatives, and the "No Action" alternative. DOE has considered all scoping comments received as well as information collected during consultations with state and federal agencies and tribal governments in the preparation of the Draft EIS. The Draft EIS provides information on the methodologies and assumptions used for the analyses and identifies environmental protection measures (EPMs) and BMPs that could prevent or minimize the potential environmental impacts of the Project. CEQ NEPA regulations require that a Draft EIS identify the agency's preferred alternative or alternatives, if one or more exists (see Section 2.14).

EPA will publish a Notice of Availability in the *Federal Register* announcing the comment period for this Draft EIS. DOE will publish a separate Notice of Availability for this Draft EIS in the *Federal Register,* which will include the locations, dates, and times of the public hearings regarding this Draft EIS and identify the methods for submitting comments during the 90-day public comment period. This information can also be obtained from the Project's EIS website (http://www.plainsandeasterneis.com).

1.5.4 Final Environmental Impact Statement

Following the public comment period for this Draft EIS, DOE will prepare a Final EIS. The Final EIS will contain public comments received on the Draft EIS and DOE's responses to those public comments. The environmental analyses will be updated or revised, as needed. The Final EIS will identify DOE's preferred alternative. EPA will publish a Notice of Availability of the Final EIS in the *Federal Register*.

1.5.5 Record of Decision

The ROD is the formal agency decision document for the EIS process. DOE's ROD would announce and explain DOE's decision pursuant to Section 1222 of the EPAct of 2005 on whether and under what conditions to participate in the Project and describe any conditions, such as mitigation commitments, that would need to be met. DOE may issue a ROD no sooner than 30 days after EPA's Notice of Availability of the Final EIS is published in the *Federal Register*.

1.6 Consultation and Coordination with Federal, State, and Local Governments and Indian Tribes

In addition to the cooperating agencies identified in Section 1.2, DOE contacted Native American tribes and federal, state, and local agencies during the DOE EIS scoping process and, in some instances, during the development of the EIS The agencies and tribes that DOE contacted during EIS scoping are listed in Tables 1.6-1 and 1.6-2, respectively, in alphabetical order.

Table 1.6-1:
Agencies Contacted during Scoping

Agency	Agency
Advisory Council on Historic Preservation	Oklahoma Secretary of Energy
Arkansas Department of Environmental Quality	Oklahoma Tourism and Recreation Department
Arkansas Farm Service Agency	Oklahoma Turnpike Authority
Arkansas Game and Fish Commission	Oklahoma Water Resources Board
Arkansas Governor Beebe's Chief of Staff	St. Francis Levee District, Arkansas

Table 1.6-1:
Agencies Contacted during Scoping

Agency	Agency
Arkansas Highway and Transportation Department	Tennessee Department of Environment and Conservation
Arkansas Historic Preservation Program	Tennessee Department of Environment and Conservation, Division of Water Resources
Arkansas Natural Heritage Commission	Tennessee Department of Environment and Conservation, Natural Areas Program
Arkansas Parks and Tourism	Tennessee Department of Environment and Conservation, Natural Heritage Inventory Program
Bureau of Indian Affairs (Cherokee Nation, Eastern Oklahoma Region, Horton Agency, Pawnee Nation, Southern Plains Region)	Tennessee Department of Transportation
Farm Service Agency (Arkansas, Oklahoma, Tennessee)	Tennessee Historical Commission
Federal Highway Administration (Arkansas, Oklahoma, Tennessee)	Tennessee Office of the Governor
Natural Resources Conservation Service (Arkansas, Oklahoma, Tennessee; Eastern Programs Division, Washington, DC)	Tennessee Valley Authority
Oklahoma Biological Survey	Tennessee Wildlife Resources Agency
Oklahoma Conservation Commission	U.S. Army Corps of Engineers (Little Rock, Memphis, and Tulsa Districts; U.S. Army Corps of Engineers Regulatory Office-Oklahoma)
Oklahoma Department of Agriculture, Food, and Forestry	U.S. Coast Guard Tennessee
Oklahoma Department of Environmental Quality	U.S. Department of Agriculture
Oklahoma Department of Transportation (Ada and Oklahoma City, Oklahoma)	U.S. Environmental Protection Agency (Regions 4 and 6)
Oklahoma Department of Wildlife Conservation	U.S. Fish and Wildlife Service (Ecological Services Offices in Arkansas, Oklahoma, Tennessee); Central Arkansas National Wildlife Refuge
Oklahoma Historical Society State Historic Preservation Office	Vance Air Force Base Oklahoma

Table 1.6-2:
Tribes Contacted during Scoping

Tribe	Tribe
Absentee-Shawnee Tribe of Indians of Oklahoma	Kiowa Indian Tribe of Oklahoma
Alabama Quassarte Tribal Town	Modoc Tribe of Oklahoma
Apache Tribe of Oklahoma	Plains Apache
Arkansas River Bed Authority	Quapaw Tribe of Indians
Caddo Nation of Oklahoma	Sac & Fox Nation, Oklahoma
Cherokee Nation	Santee Sioux Nation, Nebraska
Cherokee Nation (Real Estate Service)	Seneca-Cayuga Tribe of Oklahoma
Choctaw Nation of Oklahoma	Southern Arapaho & Southern Cheyenne
Comanche Nation, Oklahoma	The Muscogee (Creek) Nation—Eastern Oklahoma Region
Delaware Nation, Oklahoma	The Osage Nation
Delaware Tribe of Indians	Thlopthlocco Tribal Town
Eastern Band of Cherokee Indians	Tonkawa Tribe of Indians of Oklahoma
Iowa Nation, Oklahoma	United Keetoowah Band of Cherokee Indians in Oklahoma
Kaw Nation, Oklahoma	Wichita and Affiliated Tribes, Oklahoma
Kialegee Tribal Town	

As part of these communications, DOE invited the federal and state agencies and interested tribes to participate in the routing process for the HVDC transmission line related to their authority or expertise. DOE sent maps and information regarding potential routes to agencies and tribes for review and input during the development of the routing alternatives. Details of each agency and tribal involvement in the routing process are included in the Alternatives Development Report (DOE 2013).

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2. Project Description and Alternatives

2.1 Project Overview

The Applicant Proposed Project would include an overhead ± 600 kilovolt (kV) HVDC electric transmission system and associated facilities with the capacity to deliver approximately 3,500MW primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to load-serving entities in the Mid-South and southeastern United States via an interconnection with TVA in Tennessee. DOE Alternatives (as described in Section 2.4.3) would increase the capacity of the proposed transmission system and facilities by 500MW (to 4,000MW) to facilitate delivery of electricity to Arkansas. A description of the Applicant Proposed Project's major facilities and improvements is included in Section 2.1.2. Further details and information for each of the Applicant Proposed Project's major facilities, construction procedures, and environmental protection measures are included in Appendix F.

Commonly Used Terms

Throughout the Plains & Eastern EIS, the following terms are used to describe different elements of the proposal being evaluated.

Applicant Proposed Project—Based on Clean Line's modified proposal to DOE,[1] the basic elements include converter stations in Oklahoma and Tennessee, AC interconnections at each converter station, an AC collection system, and an HVDC transmission line from the Oklahoma Panhandle to western Tennessee. The Applicant Proposed Project is described in detail in Sections 2.1.2 through 2.1.7.

Proposed Action—For DOE to participate, acting through the Administrator of Southwestern, in the Applicant Proposed Project in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and possibly Texas,[2] but not Tennessee.

Applicant Proposed Route—The single 1,000-foot-wide route alternative defined by Clean Line to connect the converter station in the Oklahoma Panhandle to the converter station in western Tennessee. The analyses of impacts are typically based on a representative 200-foot-wide right-of-way (ROW) within the 1,000-foot corridor. The Applicant Proposed Route is defined in detail in Section 2.4.2.

DOE Alternatives—Pursuant to NEPA, DOE has identified and analyzed potential environmental impacts for several reasonable alternatives in addition to the Applicant Proposed Project. These alternatives include an Arkansas converter station and alternative routes for the HVDC transmission line. In each instance, these alternatives have been discussed and evaluated with Clean Line for feasibility. The DOE Alternatives are described in detail in Section 2.4.3.

The Project—A broad term that generically refers to elements of the Applicant Proposed Project and/or DOE Alternatives when differentiation between the two is not necessary. The term also refers to whatever combination of project elements would be built if a decision is made by DOE to participate with Clean Line.

2.1.1 DOE Proposed Action

DOE's Proposed Action is to participate, acting through the Administrator of Southwestern, in the Applicant Proposed Project in one or more of the following ways: designing, developing, constructing, operating, maintaining, or owning a

[1] In response to DOE's *Request for Proposals for New or Upgraded Transmission Line Projects under Section 1222 of the Energy Policy Act of 2005.*
[2] Depending on AC collection system routes implemented (some of which are in Texas).

new electric power transmission facility and related facilities located within certain states in which Southwestern operates, namely Oklahoma, Arkansas, and possibly Texas.

2.1.2 Applicant Proposed Project Description

The Applicant Proposed Project would include an overhead ± 600kV HVDC electric transmission system and associated facilities with the capacity to deliver approximately 3,500MW primarily from renewable energy generation facilities in the Oklahoma and Texas Panhandle regions to load-serving entities in the Mid-South and Southeast United States via an interconnection with TVA in Tennessee.

Major facilities associated with the Applicant Proposed Project consist of converter stations in Oklahoma and Tennessee, an approximate 720-mile, ± 600kV HVDC transmission line, an AC collection system, and access roads. The following sections summarize the Applicant Proposed Project's major facilities and improvements.

2.1.2.1 Converter Stations and Other Terminal Facilities

The Applicant Proposed Project includes two AC/ DC converter stations, one at each end of the transmission line. The Applicant proposes to locate a converter station in Texas County, Oklahoma, and a converter station in either Shelby County or Tipton County, Tennessee.[3] At each converter station, AC transmission lines would be required to connect to the existing grid. These lines would include:

- One double-circuit 345kV AC transmission line connecting to the future Xcel Energy/Southwestern Public Service Co. Optima Substation in Oklahoma
- 500kV AC transmission lines connecting to the TVA Shelby Substation in Tennessee

An additional converter station in Arkansas is also being evaluated as part of the DOE Alternatives. Information on this alternative is provided in Section 2.4.3.

2.1.2.1.1 Elements Common to the Converter Stations

Some elements are common to all of the converter stations, regardless of location. These elements are described in this section. Elements that are unique to a specific converter station are discussed in Sections 2.1.2.1.2 and 2.1.2.1.3. A converter station would be similar to a typical AC substation, but with additional equipment to convert between AC and DC. Ancillary facilities such as communications equipment and cooling equipment would be required at each converter station. In addition, AC transmission lines would connect each converter station to the existing grid. Each converter station would include:

- DC switchyard
- DC smoothing reactors
- DC filters
- Valve halls (which contain the power electronics for converting AC to DC and vice versa)
- AC switchyard
- AC filter banks

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[3] The eastern converter station would be located either in Shelby County or Tipton County, and the AC interconnection would be located at the existing Shelby substation in Shelby County.

- AC circuit breakers and disconnect switches
- Transformers

A typical converter station may require 45 to 60 acres. The AC switchyard would occupy the largest area of the electrical facility within the converter station footprint. There could be up to two buildings (valve halls) to house the power electronic equipment used in AC/DC conversion, each approximately 200 feet long by 75 feet wide. The valve halls could be 60 to 85 feet tall. Additionally, smaller buildings would house the control room, control and protection equipment, auxiliaries, and cooling equipment. Other electrical equipment may be required within the AC portion of the switchyard. The Applicant would utilize a 10- to 20-acre laydown area during construction and post construction as parking and for locating warehousing facilities within the fenced converter station if needed. Figure 2.1-1 (located in Appendix A) shows a typical converter station layout. Tables 2.1-1 and 2.1-2 provide the typical facility dimensions and anticipated land requirements for converter stations during construction and operations and maintenance.

Figure 2.1-2 (located in Appendix A) depicts the potential siting areas under consideration for the converter stations and interconnection facilities for the Project. Figures 2.1-3 and 2.1-4 (located in Appendix A) depict the converter station siting area locations in Oklahoma and Tennessee, respectively.

Typical structures for AC Interconnection include 345kV lattice structures and tubular pole structures and their respective dimensions are summarized in Tables 2.1-1 and 2.1-2. The typical pole structures for AC interconnection are depicted on Figures 2.1-5 through 2.1-10 (located in Appendix A).

2.1.2.1.2 Oklahoma Converter Station and Associated Facilities

In addition to the common features described in Section 2.1.2.1.1, the Oklahoma Converter Station would also include the features/facilities as described below. Table 2.1-1 summarizes the facilities, dimensions, and land requirements for the Oklahoma converter station.

The western terminus of the Project would interconnect to the existing transmission system operated by the Southwest Power Pool (SPP) in Texas County, Oklahoma. To facilitate this interconnection, Xcel Energy/Southwestern Public Service Company would construct a new 345kV substation called Optima. A double-circuit 345kV transmission line up to 3 miles in length would be needed to interconnect the proposed converter station with the Optima Substation. The Applicant would use a mix of lattice and tubular pole structures to support the transmission line.

The 345kV AC lines would consist of an arrangement of three electrical phases, each with a two-conductor bundle (two subconductors) in a vertical configuration with approximately 18 to 24 inches of separation between the subconductors. Each conductor would be an approximate 1- to 1.5-inch-diameter aluminum conductor with a steel reinforced core, or a very similar configuration. The exact height of each structure and required vertical clearances would be governed by topography and safety requirements. The Applicant would design minimum conductor height above the terrain, assuming no clearance buffers, per Rule 232D of the 2012 edition of the National Electrical Safety Code (NESC), which requires 25 feet for general areas and vehicular traffic (for a 345kV AC line). The NESC provides for minimum distances between the conductors and the ground, crossing points of other lines and the transmission support structure, and other conductors, and minimum working clearances for personnel during energized operations and maintenance activities (IEEE 2011).

Table 2.1-1:
Oklahoma Converter Station and Associated Facilities Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
Converter Station	45 to 60 acres of land would be required for the station, plus an additional 5 to 10 acres for construction.	45 to 60 acres of land would be required for the station; approximately 45 acres would be fenced.
Converter Station Access Roads	All weather access roads 20 feet wide x less than 1 mile long would be required. Construction of the access roads may disturb an area up to 35 feet wide.	20-foot-wide paved roadways.
ROW	One 345kV ROW; 150–200 feet wide x 3 miles long.	One 345kV ROW: 150–200 feet wide x 3 miles long.
345kV—Lattice Structures	Structure assembly area: 150 feet wide (ROW width) x 150 feet long (within ROW) 5 to 7 structures per mile. 3 miles x 6 structures per mile = 18 structures for 345kV AC.	Structural footprint 28 feet x 28 feet (typical for lattice structures) 75 to 180 feet tall; 5 to 7 structures per mile.
345kV—Tubular Pole Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW); 5 to 7 structures per mile.	Structural footprint 7 feet x 7 feet (typical for tubular pole structures) 75 to 180 feet tall; 5 to 7 structures per mile.
AC Interconnection Point	Inside the Xcel Energy/Southwestern Public Service Co., substation that is planned to be built in the future (identified by transmission planning studies as Optima).	Inside the Xcel Energy/Southwestern Public Service Co. substation that is planned to be built in the future (identified by transmission planning studies as Optima).

1 Final design and/or dimensions may differ from typical dimensions expressed here.

2.1.2.1.3 Tennessee Converter Station and Associated Facilities

In addition to the common features described in Section 2.1.2.1.1, the Tennessee converter station would also include the following features/facilities. Table 2.1-2 summarizes the facilities, dimensions, and land requirements for the Tennessee converter station. Based on preliminary designs and studies, this converter station would have a nominal capacity of 3,500MW.

The proposed eastern converter station would interconnect to the existing transmission system operated by TVA at the existing Shelby Substation, located in Shelby County, Tennessee, which sits adjacent to the county line of Tipton County. Based on TVA's final Interconnection System Impact Study (SIS), TVA would need to make substation and transmission upgrades to accommodate interconnection of the Project to the transmission system in Tennessee. The upgrades to the TVA transmission system are described in more detail in Section 2.5.2 and are addressed as connected actions in this EIS.

The interconnection would consist of 500kV AC transmission lines up to a mile long and/or associated new electrical hardware. The Applicant would use a mix of lattice and tubular pole structures to support the transmission line. It is anticipated that the AC interconnection facilities would be contained wholly within the Tennessee converter station siting area, which is shown on Figure 2.1-4 (located in Appendix A).

The 500kV AC lines would consist of an arrangement of three electrical phases each with a three-conductor bundle (i.e., three subconductors) in a triangle configuration about 18 to 24 inches on each side. Each conductor would be an approximate 1- to 2-inch-diameter aluminum conductor with a steel reinforced core, or a very similar configuration. The Applicant would design minimum conductor height above the terrain, assuming no clearance buffers, per Rule 232D of the 2012 edition of the NESC, which requires 29 feet for general areas and vehicular traffic (for a 500kV AC line). The 500kV lattice and tubular pole structures are shown in Figures 2.1-11 and 2.1-12 through 2.1-16, respectively, in Appendix A.

Table 2.1-2:
Tennessee Converter Station and Associated Facilities Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
Converter Station	45 to 60 acres of land would be required, plus an additional 5 to 10 acres for construction.	45 to 60 acres of land would be required for the station; approximately 45 acres would be fenced.
Converter Station Access Roads	All weather access roads 20 feet wide x less than 1 mile long would be required. Construction of the access roads may disturb an area up to 35 feet wide.	20-foot-wide paved roadways.
ROW	One 500kV ROW: 150–200 feet wide x up to 1 mile long.	One 500kV ROW: 150–200 feet wide x up to 1 mile long.
500kV—Lattice Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile (1 mile x 6 structures per mile = 6 structures for 500kV AC.	Structural footprint 28 feet x 28 feet (typical for lattice structures), 75 to 180 feet tall, 5 to 7 structures per mile.
500kV—Tubular Pole Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint 7 feet x 7 feet (typical for tubular pole structures) 75 to 180 feet tall, 5 to 7 structures per mile.
AC Interconnection Point	Inside the existing Shelby Substation	Inside the existing Shelby Substation

1 Final design and/or dimensions may differ from the typical dimensions expressed here.

2.1.2.2 HVDC Transmission Line

The Applicant Proposed Project would transmit energy from the Oklahoma converter station to the Tennessee converter station via an approximate 720 mile ± 600kV HVDC overhead electric transmission line. HVDC transmission technology includes the ability for bi-directional power flow, or the flow of power in either direction through the converters. Under normal operating conditions for the Project, power would flow from the wind farms (directly connected to the Oklahoma converter station via the AC collection system) in an eastward direction with power injection in Arkansas (under a DOE alternative) and Tennessee. Because of its unique characteristics as a direct current interconnection, system operators in each of the three states could utilize the Project to help stabilize the regional electric grids by changing the direction of power flow in sub-second intervals, if necessary. In these rare conditions, power could be injected from the Project to the western SPP in Oklahoma. The power for injection into the Oklahoma grid could come from either of two sources: (1) power generated from the wind farms connected through the AC collection system, or (2) power from the Arkansas or Tennessee electrical grids temporarily flowing westward into Oklahoma.

As part of its Applicant Proposed Project, Clean Line proposed one route for the HVDC transmission line. As required by NEPA, DOE has identified and analyzed other reasonable alternative routes. To simplify and organize the analysis of impacts from the HVDC transmission line, DOE has divided the 720-mile-long transmission line into seven sequential regions, numbered Region 1 to Region 7, and describes impacts from the Applicant Proposed Project by region. All HVDC alternatives, including the Applicant Proposed Route, considered for development and analyzed as part of this EIS are described in Section 2.4 and in the Alternatives Development Report (DOE 2013). The regions potentially affected by the HVDC Applicant Proposed Route (and the counties included in each region) are listed in Table 2.1-3. Figures 2.1-17a though 2.1-17f in Appendix A present an illustration of the Project (Applicant Proposed Route and DOE alternative routes). HVDC transmission facilities, which are described in detail in Appendix F, include:

- ROW easements for the transmission line, with a typical width of approximately 150 to 200 feet
- Tubular and lattice steel structures used to support the transmission line
- Electrical conductor (transmission line) and metallic return
- Communications/control and protection facilities (optical ground wire [OPGW] and fiber optic regeneration sites).

Table 2.1-3:
Counties Potentially Affected by the Applicant Proposed Route

Feature	Length (Miles)	State	Counties
Region 1 (Oklahoma Panhandle)	115.9	Oklahoma	Texas, Beaver, Harper, and Woodward
Region 2 (Oklahoma Central Great Plains)	106.2	Oklahoma	Woodward, Major, and Garfield
Region 3 (Oklahoma Cross Timbers)	162.1	Oklahoma	Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee
Region 4 (Arkansas River Valley)	126.7	Oklahoma and Arkansas	Muskogee and Sequoyah counties, Oklahoma, and Crawford, Franklin, Johnson, and Pope counties, Arkansas
Region 5 (Central Arkansas)	113.2	Arkansas	Pope, Conway, Van Buren, Cleburne, White, and Jackson
Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)	54.5	Arkansas	Jackson, Cross, and Poinsett
Region 7 (Arkansas Mississippi River Delta and Tennessee)	42.9	Arkansas and Tennessee	Poinsett and Mississippi counties, Arkansas, and Tipton and Shelby counties, Tennessee
Total Length of the Applicant Proposed Route	721.5		

2.1.2.2.1 Right-of-Way

Construction and operations of the HVDC transmission line would require ROW easements, which would typically be 150 to 200 feet wide. The analyses of impacts in Chapter 3 are based on a representative 200-foot wide ROW within a 1,000-foot corridor. The ROW easements for the HVDC transmission line would be identified within the selected corridor. The final location of the ROW within the corridors for the HVDC transmission line would be determined following the completion of the NEPA process, engineering design, and ROW acquisition activities. Figure 2.1-18 (located in Appendix A) depicts the ROW requirements for the HVDC transmission line.

The width of easements is related to the required clearance distances for the conductors, which are dictated by the NESC. They are directly related to the structure height, span width, and terrain. The width of an easement would be wider than typical where tall structures, wider spans, or terrain demands greater horizontal clearance to maintain safe clearances. To date, the Applicant has identified two locations where the easement would be significantly wider than the typical 150 to 200 feet. These include the Arkansas River and the Mississippi River crossings, where the easement could be as wide as 200 to 550 feet. Preliminary engineering indicates that the easement widths in these two locations are likely to be near the middle of this range.

Section 2.1.3 provides information relating to the acquisition of ROW easements and Section 2.1.5.1 describes restrictions on other uses within the ROW during operations and maintenance.

2.1.2.2.2 Structures

The structures used to support the HVDC transmission line would be constructed using a mix of either tubular (monopole) or lattice steel and would typically range in height from 120 to 200 feet. Structure heights, span lengths, and vertical clearance would be determined in accordance with the NESC, the Applicant's design criteria, and applicable standards and laws. The Applicant may use taller structures in circumstances where additional clearances and/or longer spans are required. The dimensions and land requirements of typical lattice and monopole structures are summarized in Table 2.1-4 and depicted in Figures 2.1-19 through 2.1-21 (located in Appendix A). In addition to typical structures, there would be limited use of lattice crossing structures (presently planned for the crossing of the Mississippi River and the Arkansas River). These crossing structures would be constructed of lattice steel and could approach 350 to 380 feet in height at the Mississippi River crossing and 200 to 250 feet in height at the Arkansas River crossing (up to 200 feet on the western bank and up to 250 feet on the eastern bank) in order to maintain necessary clearance over the navigable channels. There could also be limited use of guyed structures, either tubular or lattice steel.

The span length for a transmission line is measured along the centerline between structures. For perspective, a structure spacing of six structures per mile would result in an average span length of 880 feet. At the Arkansas River, preliminary engineering indicates that the span length would be approximately 2,000 feet. At the Mississippi River, preliminary engineering indicates that the span length would be approximately 3,300 feet. These preliminary estimates are subject to change based on final engineering and site conditions (e.g., soil, structural, or geotechnical constraints).

Table 2.1-4:
HVDC Transmission Line Facility Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
ROW	200 feet wide x approximately 720 miles long.	200 feet wide x approximately 720 miles long.
Lattice Structures	Structure assembly area 200 feet wide (ROW width) x 200 feet long (within ROW), 4 to 6 areas per mile (one for each structure).	Structural footprint 28 feet x 28 feet (typical); 120 to 200 feet tall, 4 to 6 structures per mile.
Monopole Structures	Structure assembly area 200 feet wide (ROW width) x 200 feet long (within ROW), 5 to 7 areas per mile (one for each structure).	Structural footprint 7 feet x 7 feet (typical); 120 to 160 feet tall, 5 to 7 structures per mile.
Guyed Structures	Structure assembly area 200 feet wide x 300 feet long with the ROW as necessary in limited situations.	Structural footprint 7 feet x 7 feet typical (does not include guy wire[s]), 120 to 200 feet tall, as necessary in limited situations.
Lattice Crossing Structures	Structure assembly area 200 to 550 feet wide x 300 feet long as necessary in limited situations (e.g., Mississippi River and Arkansas River crossings), assumed within the 1,000-foot-wide corridor.	Structural footprint 70 feet x 70 feet (380-foot-tall version) 200 to 380 feet tall as necessary in limited situations.
Fiber Optic Regeneration Sites	100 feet wide x 100 feet long with one site every 50 to 55 miles (720 miles/1 site every 50 miles = approximately 14 sites), typically outside the ROW (but within 750 feet) and within the 1,000-foot-wide corridor.	100 feet wide x 100 feet long, 75 feet wide x 75-foot-long fenced area, control building 12 x 32 feet and 9 feet tall and within the fenced area, permanent access road to the fenced area, power supply to control building, backup power generator and fuel supply.

1 Final design and/or dimensions may differ from typical dimensions expressed here.

The Applicant would select structure types at locations along the Project ROW based on these and other factors: land use, engineering efficiency, and existing facilities. Generally, the Applicant expects to use lattice structures for longer spans in open and wooded terrain and tubular (monopole) steel structures for spans that are shorter in length. The Applicant anticipates using guyed structures only in open grass or shrub terrain.

The Applicant would use either galvanized or weathering steel structures. Pier foundations, screw piles, caissons, concrete footings, guying, or other appropriate foundations would support the structures based on engineering considerations, cost, and land use. Structures would be directly embedded if loading and soil conditions at a specific site allow for direct burial. The structure footprint would vary by structure type as provided in Table 2.1-4.

The Applicant would complete final design for the HVDC transmission line after a final route has been chosen and subsequent detailed engineering studies and ROW acquisition activities have been completed. The final design and location of the transmission line would be consistent with the project description and analysis contained in the Plains and Eastern EIS. Drawings of the guyed structures are included as Figures 2.1-22 through 2.1-24 (located in Appendix A). A lattice crossing structure is shown in Figure 2.1-25 (located in Appendix A).

Further information and details regarding the HVDC transmission line including conductor types, metallic return, optical ground wire, communication facilities, and fiber optic regeneration sites are included in Appendix F.

2.1.2.3 AC Collection System

In addition to the HVDC transmission line, the Applicant Proposed Project would also include construction and operations and maintenance of AC collection system transmission lines to collect energy from generation resources in the Oklahoma and Texas Panhandle regions. The collection system would consist of four to six AC transmission lines up to 345kV from the Oklahoma converter station to points in the Oklahoma and Texas Panhandle regions to facilitate efficient interconnection of wind energy generation. Components of the AC collection system include:

- ROW easements for the transmission line, with a typical width of 150 to 200 feet
- Tubular or lattice steel structures used to support the transmission line
- Electrical conductor
- Communications/control and protection facilities (optical ground wire (OPGW) and fiber optic regeneration sites)

The Applicant expects that the points of interconnection from generation facilities would be located in the Oklahoma Panhandle and the Texas Panhandle, within approximately 40 miles of the Oklahoma converter station. The Applicant based the 40-mile radius on preliminary studies of engineering constraints and wind resource data, industry knowledge, and economic feasibility. Wind energy generation facilities (wind farms) would connect to the AC collection system by way of a number of possible configurations. These configurations could range in size from a direct tap, a bus ring, or even a small substation (about 2 to 5 acres in size) with transformer and switching equipment. The type and size of these AC connections is unknown at this time; the final design of these facilities would depend on a number of factors including their location, the number of connections, and the nameplate capacity and voltage of generation facilities.

Figures 2.1-17a and 2.1-26 (in Appendix A) depict the siting area for the AC collection system in the Oklahoma and Texas Panhandle regions. This EIS refers to possible locations of the AC collector lines as the AC collection system routes. These routes do not represent alternatives for DOE selection. Rather, future development of AC transmission lines within these possible routes would be driven by the locations of wind farms that may be constructed in the future to connect to the Project. Of the 13 possible routes identified, the Applicant anticipates that only 4 to 6 of these routes would be developed (Clean Line 2014b). The counties crossed by the AC collection system routes are provided in Table 2.1-5. Table 2.1-6 provides the typical facility dimensions and land requirements for construction and operations and maintenance of the AC collection facilities.

Table 2.1-5:
Counties Potentially Crossed by the AC Collection System Routes

Route	Length (Miles)	State	Counties
E-1	29.0	Oklahoma	Texas and Beaver
E-2	40.0	Oklahoma	Texas and Beaver
E-3	40.1	Oklahoma	Texas and Beaver
NE-1	29.9	Oklahoma	Texas
NE-2	26.2	Oklahoma	Texas
NW-1	51.9	Oklahoma	Texas and Cimarron
NW-2	56.0	Oklahoma	Texas and Cimarron
SE-1	40.2	Oklahoma	Texas
		Texas	Hansford and Ochiltree
SE-2	13.3	Oklahoma	Texas
		Texas	Hansford
SE-3	49.0	Oklahoma	Texas and Beaver
		Texas	Ochiltree
SW-1	13.3	Oklahoma	Texas
		Texas	Hansford
SW-2	37.0	Oklahoma	Texas
		Texas	Hansford and Sherman
W-1	20.8	Oklahoma	Texas

Table 2.1-6:
AC Collection System Facility Dimensions and Land Requirements

Facility	Construction Dimensions[1, 2]	Operation Dimensions[1, 2]
ROW	Four to six 345kV ROWs each: 150–200 feet wide x extending up to 40 miles from the converter station, (assumes 300 miles of 345kV for the AC collection system on the western end of the Project).	Four to six 345kV ROWs each: 150–200 feet wide x extending up to 40 miles from the converter station
345kV—Lattice Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint 28 feet x 28 feet (typical for lattice structures) 75 to 180 feet tall, 5 to 7 structures per mile.
345kV—Tubular Pole Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile, (300 x 6 structures per mile = 1,800 total structures for 345kV AC, it is assumed that half [900] would be monopole).	Structural footprint 7 feet x 7 feet (typical for tubular pole structures), 75 to 180 feet tall, 5 to 7 structures per mile.

Table 2.1-6:
AC Collection System Facility Dimensions and Land Requirements

Facility	Construction Dimensions[1, 2]	Operation Dimensions[1, 2]
345kV H-Frame Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint two poles spaced 25 feet apart each with a 7 feet x 7 feet footprint (typical for H-frame structures) 75 to 180 feet tall, 5 to 7 structures per mile.
Fiber Optic Regeneration Site	100 feet wide x 100 feet long (outside the ROW), 345kV: approximately 6 sites required, outside the ROW and near the ROW (within 750 feet) but not necessarily abutting the ROW.	100 feet wide x 100 feet wide, 75 feet wide x 75-foot-long fenced area, control building 12 x 32 feet and 9 feet tall, within the fenced area, permanent access road to the fenced area, power supply to control building, backup power generator and fuel supply

1 Final design and/or dimensions may differ from typical dimensions expressed here.
2 The AC collection system transmission lines may not consist of a straight line from the converter station to the wind farms and therefore could be longer than 40 miles.

2.1.2.3.1 Right-of-Way

ROW easements for the AC transmission lines, with a typical width of approximately 150 to 200 feet, would be required. The ROW requirements for the AC transmission line are depicted on Figure 2.1-27 (located in Appendix A). Restrictions on other uses within the ROW during operations and maintenance are described in Section 2.1.5.1. Section 2.1.3 provides information relating to the acquisition of ROW easements.

2.1.2.3.2 Structures

The structures used to support the AC transmission lines would be constructed of either tubular (monopole) or lattice steel and would generally range in height from 75 to 180 feet. The Applicant would determine structure heights, span lengths, and vertical clearance in accordance with the NESC, the Applicant's design criteria, and all applicable standards and laws. The Applicant may use taller structures in circumstances where additional clearances and/or longer spans are required based on engineering review.

The Applicant would construct the structures of either galvanized or weathering steel. Pier foundations, screw piles, caissons, concrete footings, guying, or other appropriate foundations would support the structures based on engineering considerations, cost, and land use. Structures could be directly embedded if loadings and soil conditions at a specific site allow for direct burial. The structural footprint would vary by structure type as described in Table 2.1-6 and depicted in Figures 2.1-5 through 2.1-10 (located in Appendix A).

Further information and details regarding the analytical assumptions for the AC collection system including conductor types, metallic return, optical ground wire, communication facilities, and fiber optic regeneration sites are included in Appendix F.

2.1.2.4 Access Roads

Access roads would be necessary for the Project. The Applicant would use existing access roads, improve existing roads where necessary, and build new roads where required to access facilities, transmission ROWs, structures, fiber optic regeneration sites and work areas during construction, operations and maintenance. The Applicant does not anticipate the need for a permanent access road along the entire length of transmission line ROWs. The Applicant would use existing roads to the extent practicable and would locate access roads between structures in active agricultural areas along fence lines or field lines where practicable to minimize impacts. Where existing roads are not available, the Applicant would construct new roads. Paving of roads would be limited to approach aprons at intersections with existing paved roads and all-weather access roads to converter stations, unless otherwise required by jurisdictional authorities.

Site conditions, engineering design, construction requirements, adopted environmental protection measures and relevant permits would govern the specific locations of proposed new access roads. The Applicant's road construction standards would comply with the applicable jurisdictions' requirements.

The road types, definitions and the typical access road dimensions during construction and operations and maintenance are included in Table 2.1-7. Typical access roads are depicted on Figure 2.1-28 (located in Appendix A).

Table 2.1-7:
Access Roads Dimensions and Land Requirements

Road Type	Definition	Construction Dimensions[1]	Operation Dimensions[1]
Existing Roads			
Existing Roads with No Improvements (Public and Private Roads)	Existing roads with no improvements include public roads maintained by local or state jurisdictions. Private roads that can support construction traffic with no improvements are also included in this category.	Existing roads that require no improvements would support construction of the Project as is. No road construction or ground disturbance expected.	Roads would be retained as is where practical for maintenance and operations.
Existing Roads that May Need Repairs (Private Roads)	Existing roads that may need repairs include most dirt and unimproved two-track roads on private land (not publically maintained roads), which are generally in a condition that supports construction traffic with repairs in some spots. No improvements to public roads are planned for construction. Examples of repairs would include grading to remove potholes or surface ruts over short distances. In many cases, grading would include reshaping the surface to promote drainage from the travel surface. In some cases, it may be necessary to replenish and re-grade gravel-surfacing material.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. Construction disturbance would typically include a total corridor up to 35 feet wide for these roads in limited areas where repairs are needed. It is assumed that the new disturbance width would be reduced by the width of the existing road (e.g., 35-foot-wide construction corridor – 16-foot-wide existing road = 19-foot-wide new disturbance). In areas with steep side slopes (greater than 15%), the construction disturbance corridor may be up to 50 feet wide.	Roads would be retained as is where practical for maintenance and operations.

Table 2.1-7:
Access Roads Dimensions and Land Requirements

Road Type	Definition	Construction Dimensions[1]	Operation Dimensions[1]
Existing Roads that Need Improvements (Private Roads)	Existing roads that need improvements include private roads along which modifications to alignment, structural improvements, or drainage improvements would be required before they could be used for construction and/or operations and maintenance of the Project. These roads could not support construction traffic without significant upgrades. Examples include private roads that traverse numerous drainages, exhibit severe rutting, or have sharp switchbacks. Structural improvements typically involve excavation and replacement of unstable roadbed with structural embankment fill over geotextile and gravel surfacing.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. Construction disturbance would typically include a total corridor up to 35 feet wide for these roads. It is assumed that the new disturbance width would be reduced by the width of the existing road (e.g., 35-foot-wide construction corridor – 16-foot-wide existing road = 19-foot-wide new disturbance). In areas with steep side slopes (greater than 15%), the construction disturbance corridor may be up to 50 feet wide.	Roads would be retained as constructed where practical for maintenance and operations.
New Roads			
New Overland Travel Roads (no improvements needed) (Private Roads)	Overland-travel roads include routes that are created by direct vehicle travel over low-growth vegetation and do not require clearing or grading. Existing low-growth vegetation would be maintained where practicable.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. There would be no clearing or grading for these roads. Construction traffic would occur over an area 14-20 feet wide.	Roads would be retained where practical for maintenance and operations. The Applicant estimates that 75% of these roads would be retained for operations and maintenance access. The remaining 25% would be abandoned and terrain would be restored to the extent practicable.
New Overland Travel Roads with Clearing (Private Roads)	New overland travel roads with clearing include overland travel routes that require clearing and minor grading using heavy machinery to remove larger vegetation or other obstructions in some locations to ensure safe vehicle operation and access.	Typically, 14-foot-wide travel surface at straight sections and 16 to 20 feet wide at corners. Construction disturbance would typically include a total corridor up to 35 feet wide for these roads. In areas with steep side slopes (greater than 15%), the construction disturbance corridor may be up to 50 feet wide.	Roads would be retained as constructed where practical for maintenance and operations. The Applicant estimates that 90% of these roads would be retained for operations and maintenance access. The remaining 10% would be abandoned and terrain would be restored to the extent practicable.

Table 2.1-7:
Access Roads Dimensions and Land Requirements

Road Type	Definition	Construction Dimensions[1]	Operation Dimensions[1]
New Bladed Roads (Private Roads)	New bladed roads may be constructed to access structures in steep or uneven terrain. Bladed roads are generally used on side slopes greater than 8% and are shaped to provide drainage. New bladed roads are typically un-surfaced unless required by the applicable jurisdiction, although gravel surfacing may be required where soil and moisture conditions would otherwise contribute to surface erosion or rutting.	Construction disturbance for these roads would typically be 35 feet wide (for 90% of the new bladed roads used for the Project). In areas with steep side slopes (greater than 15%), construction disturbance may be up to 50 feet wide. (It is assumed that less than 10% of new bladed roads for the Project would be up to 50 feet wide.)	Roads would be retained as constructed where practical for maintenance and operations. The Applicant estimates that 90% of these roads would be retained for operations and maintenance access. The remaining 10% would be abandoned and terrain would be restored to the extent practicable.

1 Final design and/or dimensions may differ from typical dimensions expressed here.

As described in Section 2.4 of Appendix F, the Applicant used a desktop analysis of 10 existing high-voltage transmission lines (10-mile reference lines) across the Project area in the proximity of the Applicant Proposed Route and DOE alternative routes. The Applicant used engineering judgment to estimate the typically required length and type of access roads necessary for construction of these reference lines and to estimate the percent of access roads typically inside and outside of the Project ROW. The typical values derived from this desktop analysis were applied for the length of the HVDC and AC transmission lines to develop the estimated access road miles for the Project. The estimated length (by road type within each state) for access roads associated with HVDC and AC transmission lines (which includes those associated with the fiber optic regeneration sites)is provided in Table 2.1-8 and 2.1-9, respectively. The Applicant would use existing public roads during construction and operations and maintenance of the Project to the extent practicable, and has no plans for improvements to public roads.

Table 2.1-8:
Estimated Access Road Miles by Road Type for HVDC Transmission Lines

Road Type	OK	AR	TN	Totals
Existing Roads that Need Improvements (miles)	45	64	4	113
Existing Roads that May Need Repairs (miles)	145	44	3	192
New Overland Travel Roads (miles)	269	180	11	460
New Overland Travel Roads with Clearing (miles)	91	75	4	170
New Bladed Roads (miles)	25	23	4	52
Totals (miles)	575	386	26	987
Total Disturbance (acres)	1,400	1182	78	2,660
Road Miles In ROW (percentage)	55	77	58	
Road Miles Outside ROW (percentage)	45	23	42	
Inside ROW (acres)	770	910	45	
Outside ROW (acres)	630	272	33	

Table 2.1-9:
Estimated Access Road Miles by Road Type for AC Transmission Lines

Road Type[1]	OK/TX[2]	AR	TN	Totals
Existing Roads that Need Improvements (miles)	5	2	1	8
Existing Roads that May Need Repairs (miles)	27	1	1	29
New Overland Travel Roads (miles)	253	3	1	257
New Overland Travel Roads with Clearing (miles)	0	2	1	3
New Bladed Roads (miles)	2	1	1	4
Totals (miles)	287	9	5	301
Total Disturbance (acres)	643	22	4	669
Road Miles In ROW (percentage)	85	78	85	
Road Miles Outside ROW (percentage)	15	22	15	
Inside ROW (acres)	547	17	3	
Outside ROW (acres)	96	5	1	

1 AC transmission lines include those proposed for AC interconnection at the converter stations and those proposed for the AC collection system.

2 The column for access road miles represents both Oklahoma and Texas and is not further segregated since the locations of the actual AC transmission lines for the AC collector system are not yet known and would be determined based on the locations of future wind farms.

2.1.3 Easements and Property Rights

Prior to construction, the Applicant or DOE, if it elects to participate in the Project, would acquire property interests from owners of land along the path of the Project. These interests could take the form of a temporary easement to allow for access roads and storage yards that will be needed during construction. They could also take the form of longer term easements or fee estates (i.e., full ownership), for siting transmission line structures, converter stations, and other facilities.

Any property interests in land needed for the Project would be acquired through a negotiated sale or eminent domain proceedings, where the land owners would be compensated for their property interests. According to the Applicant's expressed intent, the first step would be for the Applicant to offer compensation to landowners in exchange for easements or other property interests needed for the Project. If the Applicant is unable to acquire the necessary property interests from a landowner through a negotiated agreement, DOE may choose to acquire those property interests through a negotiated agreement for compensation. Where a negotiated agreement is not possible, DOE may in appropriate circumstances exercise the federal government's eminent domain authority to acquire the interests. Consistent with the Constitution of the United States and other applicable law, the landowner would be paid just compensation for the real estate interest. Real estate acquisition by federal entities, such as DOE, is governed by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) (42 USC 4601 et seq.). DOE must also comply with 49 CFR Part 24, Subpart B, "Real Property Acquisition," the government-wide regulation that implements Public Law 91-646.

2.1.4 Proposed Project Construction

This section provides an overview for typical construction activities associated with different elements of the Project. A detailed description of construction of the converter stations, HVDC and AC transmission lines, AC collection system, and access roads is provided in Appendix F. Appendix F also provides estimates of the construction workforce, crew types (based on construction activities), crew numbers, average daily production rates per crew, construction equipment, local traffic from construction, and local vs. non-local workers.

The Applicant would implement the EPMs listed in Appendix F to avoid or minimize potential impacts from construction of the Project. Construction activities described in Appendix F would incorporate and be subject to the Environmental Protection Measures as well as measures/requirements imposed as part of federal or state permits and authorizations. The implementation and monitoring of these EPMs are discussed in Section 3.1 of the Plains & Eastern EIS.

The construction of a typical converter station would include:

- Land surveying and staking
- Pre-construction surveys for biological and cultural resources
- Clearing and grubbing, grading, and construction of all-weather access roads
- Fencing
- Compaction and foundation installation
- Installation of underground electrical raceways and grounds
- Steel-structure erection and area lighting
- Installation of insulators, bus bar, and high-voltage equipment
- Installation of control and protection equipment
- Placement of final crushed-rock surface
- Installation of security systems, including cameras
- Testing and electrical energization

The construction of a typical converter station would begin with survey work, geotechnical sample drillings, and soil resistivity measurements. The site-development work would include grubbing and reshaping the general grade to form a relatively flat (1 percent slope maximum) working surface. This effort also would include the construction of all-weather access roads. The Applicant would erect a chain-link fence (8 to 10 feet tall) around the perimeter of the station to prevent unauthorized personnel from accessing the construction and staging areas. The perimeter fence would be a permanent safety feature to prevent the public from accessing the station. The Applicant would compact the excavated and fill areas to the required densities to allow structural foundation installations. Following the foundation installation, underground electrical raceways and copper ground-grid installation would take place, followed by steel-structure erection and area lighting. The steel-structure erection would overlap the installation of the insulators and bus bar as well as the installation of the various high voltage apparatus (typical of an electrical substation). The installation of the high voltage transformers would require special high-capacity cranes and crews (as recommended by the manufacturer) to be mobilized for the unloading, setting-into-place, and final assembly of the transformers.

Construction activities for the HVDC and AC transmission lines would typically include the following activities:

- Preparation of multi-use construction yards
- Pre-construction surveys for biological and cultural resources
- Preparation of the ROW
- Clearing and grading
- Foundation excavation and installation
- Structure assembly and erection
- Conductor stringing
- Grounding
- Cleanup and site restoration

Figure 2.1-29 located in Appendix A illustrates these activities and the typical transmission construction sequence.

The duration of construction is expected to be approximately 36 to 42 months for the entire Project, including the time from initiation of clearing and grading through cleanup and restoration. The actual construction duration would depend on a number of factors such as weather and availability of labor. The Applicant would most likely divide the construction of the HVDC transmission line into several segments with multiple contractors working concurrently on different portions of the route to accomplish this schedule and to maintain effective management of construction activities and allocation of resources. For the purposes of estimating resource needs for construction, the Applicant has assumed that the HVDC transmission line would be divided into five construction segments of approximately 140 miles in length. The Applicant would construct the four to six AC collection lines that would range in length from 13 to 56 miles, depending on the routes required (based on the location of future wind farms) (see Table 2.1-5). The construction crews would complete each of the individual activities required for construction along each segment in assembly line fashion (see Figure 2.1-29 in Appendix A and Appendix F). Construction may be active on any or all segments at any given time and activities may occur in parallel with other segments or staggered.

The Applicant expects that the duration of construction for either a HVDC segment or a shorter AC collection system route would be approximately 24 months from mobilization of equipment to site restoration. The construction personnel peak in any HVDC segment (or AC collection system route) would be approximately 290 workers. This peak would occur when the structure setting operations begin, while several other operations are occurring at the same time. The size, number, and average daily production of each crew type are included in Appendix F, along with an estimate of construction workforce over time. The Applicant would stage construction on each segment from multi-use construction yards located at regular intervals (approximately every 25 miles) along the route.

Project-wide, the workforce would reach a peak of approximately 1,700 workers. The average workforce across the Applicant Proposed Project would be approximately 965 people.

2.1.4.1 Temporary Construction Areas

Temporary construction areas would be required to support construction. Temporary multi-use construction yards and fly yards (landing areas for helicopters used during construction) would be used for staging construction personnel and equipment, and for storage of materials to support construction activities. Tensioning and pulling sites and wire-splicing sites (described in more detail below) would also be staged at 2- to 3-mile intervals along the Project ROW. Typically (with the exception of tensioning and pulling sites addressed below), temporary construction areas would be outside the ROW. These areas would be sited at regular intervals and at convenient distances (described below) from the facilities being constructed for the Project.

2.1.4.1.1 Tensioning and Pulling Sites

Tensioning and pulling sites would typically be approximately 2 to 3 miles apart. Land requirements for typical tensioning and pulling sites (listed in Appendix F) would be either entirely within the ROW or partially outside the ROW, depending on the structure type (e.g., mid-span or deadend). Where the transmission line turns (requiring a deadend structure type), the tensioning and pulling sites may extend outside of the ROW to maintain a straight line with the ground wire and conductor being pulled as shown in Figure 2.1-30 (located in Appendix A).

2.1.4.1.2 Multi-use Construction Yards

Multi-use construction yards would be used primarily for staging of construction personnel and equipment and for material storage to support construction activities (Figure 2.1-31 in Appendix A). The Applicant would locate multi-use construction yards outside the ROW and typically at intervals of approximately 25 miles. Additionally, they would be located within approximately 10 miles of the ROW or Project facility. Typical multi-use construction yards would be approximately 25 acres in size, fenced, and access-controlled.

The Applicant may arrange individual multi-use construction yards differently, but typical sites would include areas designated for a field office, crew parking, sanitation, waste management, fueling, equipment wash, material storage, equipment storage, and fly yard. The Applicant would base fuel trucks, maintenance trucks, and construction crews in multi-use construction yards. The Applicant would store any fuel, lubricants, antifreeze, detergents, paints, solvents, and/or other chemicals used during construction at the multi-use construction yards consistent with standard practices and relevant permits.

Portable concrete batch plants would be located within multi-use construction yards where needed. Concrete would be required for construction of foundations for transmission structures, foundations for transformers and electrical equipment at converter stations, and foundations at fiber optic regeneration sites. Concrete would be delivered to structure sites and ancillary facilities in concrete trucks with a capacity of up to 10 cubic yards. The Applicant would obtain concrete from commercial ready-mix concrete producers to the extent practicable. In locations where haul times exceed 45 minutes (a haul distance of approximately 25 to 30 miles), concrete would be dispensed from portable concrete batch plants located within a multi-use construction yard. Based on preliminary review of commercial ready-mix plants in proximity to the Project, the Applicant may require up to four temporary batch plants for the HVDC transmission line and two for the AC collection system (where the haul distance may exceed 25 to 30 miles).

2.1.4.1.3 Fly Yards

The Applicant would use helicopters for conductor stringing operations and/or for transport and erection of structure sections during construction. The Applicant would locate helicopter landing areas (fly yards) at approximately 5-mile intervals along the ROW. Approximately 20 percent of fly yards would be collocated within multi-use construction yards. All other fly yards would be located near the ROW. Typical fly yards would be approximately 5 acres or less in size.

The Applicant may arrange individual fly yards differently, but typical sites would include areas designated for helicopter landing, crew parking, sanitation, waste management, refueling, and temporary material staging. Fly yards would be operated and maintained consistent with standard practices and relevant permits.

2.1.4.1.4 Wire Splicing Sites

Typically, wire-splicing sites would be located within the ROW. Conductors and shield wires (wires) are strung into their supporting structures over a length of two reels. The wire from the two reels would be mechanically joined at the wire ends with a temporary steel wire-gripping sleeve (stringing sock) which would pass through the stringing blocks. After the wire is strung and secured, the stringing sock would be replaced with a compression splice connector. The splice connector installation would occur at the wire splicing site. Typical wire splicing sites include a wire splicing truck and a line truck to facilitate installation.

2.1.4.1.5 Fiber Optic Cable Regeneration Sites

As a data signal passes through fiber optic cable, it degrades with distance. This data signal must be regenerated or amplified every 50 to 55 miles at fiber optic regeneration sites. The facilities and land requirements for a regeneration site are shown in Figure 2.1-32 (located in Appendix A). Fiber optic cable would be buried using the two basic methods of direct burial installation: trenching and plowing. Trenching involves digging a trench, placing the cable in the trench, and backfilling with native soils. Trenches are often dug with backhoes using narrow buckets (18 inches wide or less) to a depth of approximately 42 inches and are visually inspected for rocks or debris that could potentially damage the cable. In some instances, conduit is laid in the trench and the cable pulled through the conduit. Plowing involves a cable-laying plow designed to simultaneously excavate a ditch and lay the cable. Native soil would be used to backfill the trench.

2.1.5 Operations and Maintenance

All transmission lines would be inspected regularly or as necessary using fixed-wing aircraft, helicopters, ground vehicles, all-terrain vehicles, and/or personnel on foot. The frequency of inspections and maintenance would be meet or exceed standards, such as those specified by the NESC and North American Electric Reliability Corporation (NERC). Applicable federal, state, and local permits would be obtained prior to conducting maintenance. Maintenance activities for facilities would be similar to activities during construction but generally smaller in scale and more localized.

The ROW would be maintained during operations and maintenance in accordance with a Project-specific Transmission Vegetation Management Plan developed by the Applicant, consistent with rules developed by NERC. A wire zone (Figures 2.1-18 and 2.1-27 located in Appendix A) typically consists of low-growing grasses, legumes, herbs, crops, ferns, and shrubs where the conductor is 50 feet or less from the ground to prevent accidental grounding contact with conductors. A border zone (i.e., to the edge of the ROW) is managed to consist of tall shrubs or short trees (up to 25 feet in height at maturity), grasses, and other low-growing vegetation. In most areas, accepted standard utility practices consistent with the Transmission Vegetation Management Plan, such as tree-trimming, tree removal, and/or brush removal, would be utilized to maintain vegetation within the ROW. In addition, vegetation clearing practices may vary based on dominant plant communities.

The Applicant expects that operations and maintenance of the Project would require 72 to 87 full-time workers. This would include up to 15 workers at each of the converter stations and 42 workers in Oklahoma and Arkansas for the HVDC transmission line.

2.1.5.1 Permitted Uses within the Right-of-Way

Land uses compatible with reliability and safety requirements for HVDC and AC facilities would be permitted in and adjacent to the ROW. Existing land uses such as agriculture and grazing, vehicle and pedestrian access, recreation uses, and pre-existing compatible land uses are generally permitted. Incompatible land uses within the ROW include construction and maintenance of inhabited dwellings and any use requiring changes in surface elevation that affect electrical clearances of existing or planned facilities.

Good utility practice, NERC rules, and the planned design, maintenance, and operations of the line were used to develop height restrictions of activities within the ROW that would maintain the minimum clearance requirements as determined from the NESC. Once a route has been established, the Applicant would review the route for non-standard activities that may require adjustments to minimum clearances.

Limitations on land uses would be described in the easement agreements; these limitations could be modified in the easement based on site-specific conditions and/or coordination with landowners. Limitations on uses within the ROW could include the following:

- A prohibition on placing a building or structure within the ROW
- Restrictions on timber or orchards within the ROW
- Restrictions on grading and land re-contouring within the ROW that would change the ground surface elevation within the ROW
- Restrictions and required coordination for the construction of future allowed facilities such as fences or irrigation lines within the ROW
- Restricted access during performance of maintenance activities

2.1.5.2 Safety and Reliability

Safety and reliability are primary concerns. The Project would be designed to meet or exceed applicable criteria and requirements outlined by organizations such as the Federal Energy Regulatory Commission (FERC), NERC, NESC, SPP, TVA, the American Society of Civil Engineers, and other applicable federal, state, or local requirements. Safety measures would meet or exceed applicable occupational safety and health standards. The transmission line would be protected with circuit interruption equipment (circuit breakers, disconnects, etc.). If the conductor were to fail, power would be automatically removed from the line. Lightning protection would be provided by overhead ground wires. Electrical equipment and fencing at the converter stations would be grounded. Vegetation management would occur to minimize potential hazards; trees would be trimmed or removed to prevent accidental grounding contact.

As is done with typical transmission line operations, the Applicant would turn over functional control of the Project to a Regional Transmission Organization (RTO)/Independent System Operation (ISO) or an RTO-like entity. For the Project, this could include SPP, TVA, or a third party. Functional control of a facility means that the RTO ensures the Applicant’s tariff is administered transparently. In addition, a NERC compliance program would be established and maintained either by the Applicant or by a third party to which the compliance requirements are delegated. Coordination agreements—also known as seams agreements—would be negotiated and executed with all interconnection parties. Balancing area functions would be performed by the Applicant or a third party acting as the Transmission Operator on behalf of the Applicant.

2.1.6 Decommissioning

Decommissioning could occur at the end of the useful life and if the facilities were no longer required. However, a transmission system lifetime can exceed 80 years with proper maintenance. At the end of the service life of the Project, assuming that the facilities were not upgraded or otherwise kept in service, conductors, insulators, and structures could be dismantled and removed. The converter stations and regeneration stations, if not needed for other existing transmission line projects, could also be dismantled and removed. The station structures would be disassembled and either used at another station or sold for scrap. Access roads that have a sole purpose of providing maintenance crews access to the transmission lines could be decommissioned following removal of the structures and lines, or could be decommissioned with the lines in service if determined to no longer be necessary. The Applicant would consult with landowners to assess whether access roads may be serving a purpose for landowners, at which point in time, the Applicant may elect to leave the access roads in place. A Decommissioning Plan would be developed prior to decommissioning and would follow applicable governing requirements at that time.

2.1.7 Environmental Protection Measures

For the purpose of all analyses for the EIS, it is assumed that the Applicant would conduct each phase of the Project in compliance with applicable federal, state and local laws, regulations and permits related to construction, operations and maintenance and decommissioning of the Project. Appendix C presents an overview of potential federal and state permits and consultation that could be required for construction of the Project. Local permits and approvals would also be required for the Project.

The Applicant has developed general and resource-specific EPMs to avoid or minimize effects to environmental resources during construction, operations and maintenance, and/or decommissioning of the Project. The resource-specific EPMs include measures to protect land use; soils and agriculture; fish, vegetation, and wildlife; and waters, wetlands, and floodplains. The complete list of EPMs is presented in Appendix F. The EPMs would be made binding through the ROD and terms of participation agreements between DOE and the Applicant. The EPMs would be implemented through a combination of environmental-related plans; compliance with federal, state, and local environmental regulations; and permitting requirements. The specific environmental-related plans that the Applicant has identified and described in Appendix F include:

- Transportation and Traffic Management Plan
- Blasting Plan
- Restoration Plan
- Spill Prevention, Control and Countermeasures Plan
- Stormwater Pollution Prevention Plan
- Transmission Vegetation Management Plan
- Avian Protection Plan
- Construction Security Plan
- Cultural Resources Management Planning Documents including Historic Properties Treatment Plan and Unanticipated Discoveries Plan

The Applicant would identify certain areas as “environmentally sensitive” and take actions to avoid and/or minimize effects on these areas to the extent practicable. Environmentally sensitive areas may include: wetlands, certain water bodies, cultural resources, and wildlife habitat.

2.2 Transmission System Planning Processes

2.2.1 System Planning, Interconnections and Reliability

This section explains the processes applicable to the Applicant's requests for interconnections to the existing electrical grid, including the study and assessment of the upgrades and improvements needed for such interconnections. The details of the interconnections are provided in Sections 2.1.2.1.2, 2.1.2.1.3, and 2.4.3.1 for Oklahoma, Tennessee, and Arkansas, respectively. These interconnections are an integral part of the Project. The details of any required upgrades to the transmission systems in these states are provided in Section 2.5.2. These upgrades are being evaluated as connected actions. The Applicant's execution of interconnection agreements (which establish the basic terms and conditions of the interconnection but neither commit Clean Line to build the project nor to identify a specific route) with the two regional transmission organizations and TVA would neither have adverse environmental impacts nor limit the choice of reasonable alternatives.

2.2.1.1 Oklahoma/SPS/SPP Interconnection

Clean Line requested a Point of Interconnection in Oklahoma at the 345kV Hitchland Substation. This substation is owned by Southwestern Public Service (SPS), a subsidiary of Xcel Energy and member of the SPP RTO. This interconnection would be necessary to enable the AC to DC conversion process within the Oklahoma converter station. The interconnection between the proposed Oklahoma converter station and the SPS system would be controlled to a nominal value of zero megawatts.

For Clean Line to interconnect to the SPS system, a series of studies must be performed to review the potential interconnection and identify any upgrades to existing facilities or additions of new facilities to allow a reliable interconnection. SPS is currently performing a facilities study of the requested interconnection to the SPS 345kV system. Based on the SPS analysis completed to date, Clean Line expects that a new substation would be necessary to accommodate the interconnection due to space constraints at the existing Hitchland 345kV substation. To alleviate these space constraints, SPS has proposed a new substation nearby, tentatively named "Optima." Clean Line expects SPS to complete the facilities study by early 2015. After the completion of the facilities study for the interconnection, Clean Line's selected HVDC vendor will incorporate the facilities study results into its study work on the final converter station design. This final study work will identify specific technology solutions such as reactive power requirements and filter design that would be included in the final converter station design. Following completion of these studies, Clean Line anticipates that it would enter into an interconnection agreement with SPS and SPP for the Project.

For the purpose of ensuring integration of the Project into the SPP transmission planning process, and to ensure that the interconnection of the Project would not affect the security or reliability of the SPP system, Clean Line contracted Siemens PTI to conduct steady-state and dynamic power system studies to comply with SPP planning requirements under SPP Criteria 3.5. Clean Line and Siemens PTI presented the results of these studies to the SPP Transmission Working Group and SPP staff for review. Excel Engineering, an external consultant hired by SPP, reviewed the results and confirmed that Siemens PTI's studies were complete and correct. In November 2012, the SPP Transmission Working Group found that Clean Line's reliability study was "consistent with SPP planning processes and as having met [the Project's] coordinated planning requirements under SPP Criteria." The SPP Transmission Working Group indicated that Clean Line may need to update the study after selection of a vendor for the Project. These updates would ensure that the final design of the HVDC converter station complies with criteria set forth in the final interconnection agreement.

2.2.1.2 Arkansas/Entergy/MISO Interconnection

In response to comments received during the public scoping process, an intermediate converter station in Arkansas is being considered as a DOE Alternative (see Section 2.4.3.1). An AC interconnection would be required to deliver power from the intermediate converter station to the existing transmission system owned by Entergy Arkansas, a subsidiary of Entergy Corporation. Entergy Arkansas is part of the Mid-Continent Independent System Operator (MISO) system. Clean Line submitted the interconnection request to MISO in November 2013. Under MISO rules, interconnection requests involve three parties: the system operator (MISO), the transmission owner (Entergy Arkansas), and the interconnecting customer (Clean Line).

Clean Line began the interconnection process in Arkansas by requesting interconnection service from Entergy Arkansas for up to 500MW along the existing Arkansas Nuclear One–Pleasant Hill 500kV transmission line. Clean Line identified and proposed an AC interconnection consisting of a new 500kV transmission line connecting the proposed intermediate converter station to a new substation along the Arkansas Nuclear One–Pleasant Hill 500kV transmission line. Clean Line selected the Arkansas Nuclear One–Pleasant Hill 500kV Point of Interconnection to avoid the need for additional upgrades to the surrounding transmission system and to accommodate a 500MW injection. MISO performed a feasibility study of the request and delivered results to Clean Line in February 2014. The feasibility study showed that no network upgrades would be required to accommodate the interconnection.

Clean Line's next step in the MISO process is to enter the Definitive Planning Phase, which consists of an interconnection SIS and facilities study. The interconnection SIS and facilities study are anticipated to take six months in total to complete. Clean Line anticipates beginning the Definitive Planning Phase in 2015. Following completion of the Definitive Planning Phase process, Clean Line would enter into an interconnection agreement with Entergy Arkansas and MISO.

2.2.1.3 Tennessee Valley Authority Interconnection Process

Clean Line requested interconnection service in Tennessee at the TVA Shelby 500kV substation for interconnection of up to 3,500MW of power. To place this level of power injection in perspective, it is slightly higher than the generating capacity of TVA's only three-unit nuclear plant, and is described by Clean Line as capable of supplying electricity for over a million homes. Clean Line originally requested interconnection in late 2009, at which time TVA performed feasibility studies on the following three potential options: 500kV Shelby Substation, a combination of Cordova 500kV and Weakley 500kV substations, and a new substation that would have connected the Shelby–Lagoon Creek and Cordova–Haywood 500kV transmission lines. Based on studies of these options, Clean Line pursued interconnection at the Shelby Substation.

The final interconnection SIS, completed in March 2014, identified direct assignment facilities and network upgrades associated with the Project. Direct assignment facilities included additional bays, breakers, switches, line relays, and interchange meters to be installed within the Shelby Substation before interconnecting the Project. Direct assignment facilities are required to be constructed and in operations and maintenance to facilitate the energization of the interconnection. Network upgrade projects are those that TVA identified that would allow injection of up to 3,500MW to the TVA transmission system. Some network upgrades may be constructed after initial energization of the interconnection. The interconnection SIS identified scenarios that would be resolved by 30 network upgrades, including upratings, reconductoring, and terminal upgrades on 27 existing 161kV system elements and 3 existing 500kV system elements. The interconnection SIS also identified certain reliability scenarios that would be resolved by a new 500kV transmission line and associated substation upgrades. Following good utility practice, in accordance with a final interconnection agreement, and depending on the results of a Facilities Study, Clean Line may be asked to operate the Project in a way that restricts its full delivery capacity under some limited scenarios until completion of certain network upgrade projects. Additional details regarding these system upgrades are presented in Section 2.5.2.

The next step in the interconnection process is the performance of a Facilities Study in which TVA will determine the detailed designs, costs, and projected schedules for the identified direct assignment facilities and network upgrade projects. During the Facilities Study, TVA also will perform the transient stability analysis, which could identify additional Network Upgrades. TVA anticipates the Facilities Study work will take approximately 24 months, with an estimated completion date in mid-2016. Following completion of the Facilities Study, Clean Line would negotiate an interconnection agreement with TVA.

In addition, given the regional connection of the Shelby Substation to nearby transmission systems operated by other parties, TVA identified the need for two Affected System Impact Studies (ASIS) to evaluate any impacts from the injection of up to 3,500MW into the electric grid. Memphis Light, Gas and Water completed the first ASIS, which showed the need for two wavetraps (terminal equipment) at an existing 161kV substation. Clean Line is coordinating with MISO and Entergy to identify the scope of a second ASIS, expected to be completed within a year.

Prior to providing service as a wholesale interstate electric transmission utility in the state of Tennessee, Clean Line must obtain a certificate of public convenience and necessity (CCN) from the Tennessee Regulatory Authority (TRA) for the Project (Tennessee Code Annotated 65-4-201 and 208). Clean Line submitted an application for the CCN in April 2014 (Clean Line 2014a). To obtain the CCN, Clean Line must show that it has the managerial, technical, and financial ability to operate as a utility within the state of Tennessee, and Clean Line must also show that granting a CCN for the construction of the portion of the Project in Tennessee would serve the public interest.

2.3 Route and Alternative Development

This section briefly describes the process used to identify the proposed locations for each of the Applicant Proposed Project components and alternative routes for the HVDC transmission line. DOE independently reviewed and verified the Applicant-supplied information (per 40 CFR 1506.5[a]).

2.3.1 HVDC Route Development

Clean Line employed a multi-disciplinary team of professionals (referred to as the Clean Line Routing Team) to undertake the route identification process for the HVDC transmission line. Clean Line used a multi-stage approach to develop guidelines and criteria and to apply these guidelines and criteria to identify corridors and refine them. At each stage, Clean Line incorporated public stakeholder input on the development of criteria and the identification of corridors and routes. The Clean Line Routing Team began by identifying potential interconnection locations at the western and eastern endpoints of the Project (DOE 2013). Using these endpoints, the Clean Line Routing Team conducted a route development process that used progressively more detailed and restrictive siting criteria. Through this process, Clean Line identified the proposed converter station siting areas, the Applicant Proposed Route, and route alternatives for the HVDC transmission line.

The Clean Line Routing Team considered and utilized guidelines and criteria consistent with transmission line siting principles used by federal entities such as the Rural Utilities Service, Western, and Bonneville Power Administration.

These principles included identification of opportunity areas (e.g., existing linear corridors, areas of land consistent with or compatible with linear utilities, etc.) and sensitive resources that limited or conflicted with transmission line development (e.g., residences, schools, USFWS-designated critical habitat under the Endangered Species Act, etc.).

The Clean Line Routing Team applied general and technical guidelines intended to avoid conflicts with existing resources, developed areas, and existing incompatible infrastructure; maximize opportunities for paralleling existing compatible infrastructure; and consider land use and other factors. Clean Line's technical guidelines included considerations related to design and engineering of the transmission line. Details regarding the route development process described in the DOE Alternatives Development Report (DOE 2013) are provided in Appendix G of this EIS.

2.3.2 Converter Station Siting

The following section discusses the process that the Clean Line Routing Team used to identify each of the converter station siting areas in the Applicant Proposed Project. An additional converter station in Arkansas also is being evaluated as part of the DOE Alternatives. Information on this alternative is provided in Section 2.4.3.

2.3.2.1 Oklahoma Converter Station

The Clean Line Routing Team identified a western endpoint in Oklahoma based on its evaluation of wind resources, the existing high-voltage transmission system, land use, and environmental sensitivities. Clean Line began the identification process for the western converter station by studying a broad region of northwestern Oklahoma. Clean Line narrowed the study area by considering criteria such as wind resources, available AC transmission interconnection, regional land use compatibility, and environmental sensitivities. Clean Line identified the proposed western converter station siting area based on three primary factors: (1) proximity to a large area of concentrated high capacity factor wind resources; (2) proximity to a point on the existing or planned AC transmission system that would support the interconnection; and (3) proximity to large areas of land uses compatible with wind farm development and which are known to be relatively low in environmental sensitivities. Clean Line concluded that the Oklahoma Converter Station Siting Area best met these criteria.

2.3.2.2 Tennessee Converter Station

The Clean Line Routing Team identified an eastern endpoint in Tennessee based on its evaluation of existing transmission facilities capable of reliable interconnection and delivery of up to 3,500MW of energy to points in Tennessee and elsewhere in the Mid-South and Southeast, the level of potential upgrades required to accommodate the Project, historical transmission congestion, market access, land use, and environmental considerations. Clean Line began the identification process for the eastern converter station by studying a broad geographic region from central Arkansas to western Tennessee. Clean Line concluded that the Tennessee Converter Station Siting Area best met their site selection criteria.

2.4 Alternatives

In the Plains & Eastern EIS, DOE analyzes the potential environmental impacts of the Proposed Action, the range of reasonable alternatives, and a No Action Alternative. In addition, DOE describes below other alternatives to the Proposed Action identified during the EIS scoping process that DOE considered but eliminated from detailed analysis.

This EIS analyzes the potential environmental impacts of the entire Project. This ensures that any decision by DOE or another agency is fully informed. DOE, may decide to participate in any or all of the states in which Southwestern operates, namely Oklahoma, Arkansas, and Texas, However, DOE would not participate in the Project in Tennessee because that state is outside Southwestern's operational area. Other agencies, federal or state, may have jurisdiction over parts of the Project that are located in Tennessee. Some of these agencies could include, but not be limited to, TVA, USACE, and Tennessee state agencies.

2.4.1 No Action Alternative

This Plains & Eastern EIS analyzes a No Action Alternative, under which DOE would not participate with the Applicant in the Applicant Proposed Project or DOE Alternatives. Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not proceed and none of the potential environmental effects associated with the Project would occur.

2.4.2 Applicant Proposed Route

As identified in Section 2.1.2.2, the Applicant has proposed a specific route for the HVDC transmission line from the Oklahoma Panhandle Region to interconnect with TVA's electrical system in western Tennessee. For purposes of analysis, the Applicant Proposed Route is described below in terms of seven regions, which were based on geographic similarities and common node points along the route (where the Applicant Proposed Route and HVDC alternative routes converge). Within each region, the Applicant Proposed Route is divided into links. These links represent sections of the Applicant Proposed Route between points where alternative routes intersect with it. The alternative routes (described in Section 2.4.3.2) diverge from the Applicant Proposed Route and provide an alternative to the corresponding links of the Applicant Proposed Route. The links are labeled on the figures of the Applicant Proposed Route (Figures 2.1-17a through 2.1-17f located in Appendix A).

In some regions the Applicant Proposed Route is outside the 1-mile-wide route corridors presented at the public scoping meetings (referred to as the Network of Potential Routes). Areas where this occurs are described below. Details regarding the route development process are described in the DOE Alternatives Development Report (DOE 2013) and are summarized in Appendix G of this EIS.

2.4.2.1 Region 1 (Oklahoma Panhandle)

Region 1 includes primarily grassland/herbaceous land cover. Region 1 begins at the converter station site in Texas County, Oklahoma, and continues east through Texas, Beaver, Harper, and Woodward counties in Oklahoma approximately 116 miles to the area north of Woodward, Oklahoma. The Applicant Proposed Route in Region 1 would parallel the existing Xcel/OG&E Woodward-to-Hitchland 345kV transmission line for the majority of its length. The Region 1 Applicant Proposed Route is shown on Figure 2.1-17a (located in Appendix A).

The AC collection system is located within Region 1 and within a 40-mile radius centered on the Oklahoma Converter Station Siting Area. To facilitate efficient interconnection of wind generation, it is expected that four to six AC collection transmission lines of up to 345kV from the Oklahoma converter station to points in the Oklahoma and Texas Panhandle regions would be constructed. The Clean Line Routing Team developed thirteen 2-mile-wide AC collection system route corridors between the Oklahoma Converter Station Siting Area and wind development zones. DOE, however, will not be making decisions on the locations on these transmission lines; their location will be driven by future wind development. The AC collection system routes analyzed as part of the Applicant Proposed Project are as follows:

- E-1 parallels section lines, a natural gas transmission pipeline, and the Guymon to Beaver 115-kV electrical transmission line for the majority of its length.
- E-2 parallels the Applicant Proposed Route (HVDC) and the OG&E/Xcel Energy Hitchland to Woodward 345kV transmission line for the majority of its length.
- E-3 parallels section lines, roads, and a natural gas transmission pipeline to the extent practicable.
- SE-1 parallels the Applicant Proposed Route (HVDC), the OG&E/Xcel Energy Hitchland to Woodward 345kV transmission line, section lines and county roads to the extent practicable.
- SE-2 parallels the Finney to Hitchland 345kV electrical transmission line and the Texas County to Spearman 115kV electrical transmission line to the extent practicable.
- SE-3 parallels the Applicant Proposed Route (HVDC), the OG&E/Xcel Energy Hitchland to Woodward 345kV transmission line, section lines and county roads to the extent practicable.
- SW-1 parallels the Finney to Hitchland 345kV electrical transmission line, the Hitchland to Porter 345kV electrical transmission line to the extent practicable.
- SW-2 parallels section lines, the Texas County to Moore County 115kV electrical transmission line for the majority of its length.
- W-1 parallels sections lines and county roads to the extent practicable.
- NW-1 parallels section lines, the Texas County to Moore County 115kV electrical transmission line, county roads, and U.S. Highway 412 to the extent practicable.
- NW-2 parallels sections lines and county roads to the extent practicable.
- NE-1 parallels county roads and section lines to the extent practicable.
- NE-2 parallels section lines, the Finney to Hitchland 345kV electrical transmission line, county roads, and Oklahoma State Route 94 to the extent practicable.

The AC collection system route corridors are shown on Figures 2.1-17a and 2.1-26 (located in Appendix A).

2.4.2.2 Region 2 (Oklahoma Central Great Plains)

Region 2 includes primarily grassland/herbaceous and cultivated crop land covers. Region 2 begins north of Woodward, Oklahoma, and continues southeast through Woodward, Major, and Garfield counties in Oklahoma, for approximately 106 miles to end approximately 16 miles southeast of Enid, Oklahoma. Attributes of the Applicant Proposed Route in Region 2 include:

- The Applicant Proposed Route parallels Western Farmers Electric Cooperative's existing 115kV transmission line, U.S. Route 60, section lines and parcel boundaries, and county roads to the extent practicable.
- A portion of the Applicant Proposed Route is outside the 1-mile-wide area of Link D-2 of the Network of Potential Routes presented at the public scoping meetings. The Clean Line Routing Team sited the Applicant Proposed Route outside the Network of Potential Routes in this area to avoid several center-pivot irrigation systems that were identified during scoping.

The Region 2 Applicant Proposed Route is shown on Figure 2.1-17b in Appendix A.

2.4.2.3 Region 3 (Oklahoma Cross Timbers)

Region 3 includes primarily grassland/herbaceous, deciduous forest, and pasture/hay land covers. Region 3 begins southeast of Enid, Oklahoma, and continues southeast through Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma for approximately 162 miles and ends north of Webbers Falls, Oklahoma, at the Arkansas River. The eastern portion of Region 3 from Stillwater to the region's terminal point on the eastern end has more residential development than the other portions of Region 3. Attributes of the Applicant Proposed Route in Region 3 include:

- The Applicant Proposed Route parallels OG&E's Cottonwood Creek-to-Enid 138kV transmission line, section lines, county roads, parcel boundaries, gas pipeline, the KAMO Electric Cooperative, Inc. Stillwater-to-Ramsey 115kV transmission line, KAMO Electric Cooperative, Inc. Stillwater-to-Cushing 69kV transmission line, OG&E's Muskogee to Pittsburgh 345kV transmission line, Public Service Company (PSCo)-OK's Bristow to Silver City 161kV transmission line, and OG&E's Cushing to Bristow 138kV transmission line, and the OG&E's Beggs-to-Pecan Creek 138kV transmission line for the majority of its length.
- Portions of the Applicant Proposed Route are outside the 1-mile-wide area of Link F-7 of the Network of Potential Routes presented at the public scoping meetings. The Clean Line Routing Team sited the Applicant Proposed Route outside the Network of Potential Routes in response to scoping comments that identified additional residential areas and residences.

The Region 3 Applicant Proposed Route is shown on Figure2.1-17c in Appendix A.

2.4.2.4 Region 4 (Arkansas River Valley)

Region 4 includes primarily pasture/hay and deciduous forest land covers. Region 4 begins north of Webbers Falls in Muskogee County, in Oklahoma and continues east though Muskogee and Sequoyah counties in Oklahoma and Crawford, Franklin, Johnson, and Pope counties in Arkansas for approximately 127 miles and ends north of Russellville, Arkansas. Attributes of the Applicant Proposed Route in Region 4 include:

- The Applicant Proposed Route parallels several existing transmission lines across the Arkansas River. The Applicant Proposed Route continues into Arkansas parallel to OG&E's Muskogee-to-Fort Smith 345kV transmission, Southwestern's Gore-to-Alma 161kV transmission line, Interstate-40, Southwestern's Alma-to-Dardanelle 161kV transmission line, county roads, and parcel lines to the extent practicable.
- The Applicant Proposed Route includes the Lee Creek Variation, which refers to a route variation near the Oklahoma-Arkansas state line. It was developed by Clean Line to address concerns expressed regarding avoidance of a buffer zone around the Lee Creek Reservoir. It begins in Sequoyah County, Oklahoma, at a point approximately 1.9 miles west of the state line, where it proceeds east-northeast for approximately 2 miles, then east-southeast, ending in Crawford County, Arkansas, approximately 1.5 miles east of the state line, where it rejoins the Applicant Proposed Route.
- Portions of the Applicant Proposed Route are outside the 1-mile-wide area of Links H-I and H-5 of the Network of Potential Routes presented at the public scoping meetings. The Applicant Proposed Route was sited outside the Network of Potential Routes in this area to avoid residences and agricultural structures identified in comments submitted to DOE during scoping.

The Region 4 Applicant Proposed Route is shown on Figure 2.1-17d in Appendix A.

2.4.2.5 Region 5 (Central Arkansas)

Region 5 includes primarily pasture/hay, deciduous forest, and evergreen forest land covers. Region 5 begins north of Russellville, in Pope County, Arkansas, and continues east for 113 miles through Pope, Conway, Van Buren, Faulkner, Cleburne, White, and Jackson counties in Arkansas, and ends southwest of Newport, Arkansas. The Applicant Proposed Route in Region 5 parallels parcel boundaries and section lines, Entergy Arkansas Inc.'s Independence-to-Genpower Keo 500kV transmission line, the Cleburne County 69kV transmission line, and a natural gas transmission pipeline to the extent practicable.

The Region 5 Applicant Proposed Route is shown on Figure 2.1-17e in Appendix A.

2.4.2.6 Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)

With the exception of the Crowley's Ridge area, Region 6 primarily includes cultivated crop land covers. Region 6 begins southwest of Newport in Jackson County, Arkansas, and continues northeast through Jackson, Cross, and Poinsett counties in Arkansas, for approximately 55 miles and ends south of Marked Tree, Arkansas. Crowley's Ridge consists mostly of hardwood forest. Attributes of the Applicant Proposed Route in Region 6 include:

- The Applicant Proposed Route parallels the Entergy Arkansas Inc.'s Fisher-to-Cherry Valley 161kV transmission line, the St. Francis Levee, parcel boundaries, and county roads to the extent practicable.
- Portions of the Applicant Proposed Route in Region 6 are outside the 1-mile-wide area of Links L-3, L-4, and L-5 of the Network of Potential Routes presented at the public scoping meetings for the EIS. These deviations outside the Network of Potential Routes resulted from aligning the Applicant Proposed Route to follow an existing electrical transmission line into Cross County, Arkansas, to follow the Spoil Bank Central Canal within the St Francis Oak Donnick Floodway, and to avoid private airfields and aerial applicator operations in Poinsett County, Arkansas.

The Region 6 Applicant Proposed Route is shown on Figure 2.1-17f in Appendix A.

2.4.2.7 Region 7 (Arkansas Mississippi River Delta and Tennessee)

Region 7 includes primarily cultivated crop land covers. Region 7 begins south of Marked Tree, in Poinsett County, Arkansas, and continues east and southeast through Poinsett and Mississippi counties in Arkansas, across the Mississippi River and into Tipton and Shelby counties in Tennessee, for approximately 43 miles, ending near the Tipton-Shelby county line south of Tipton, Tennessee. Attributes of the Applicant Proposed Route in Region 7 include:

- The Applicant Proposed Route parallels Entergy Arkansas Inc.'s Marked Tree to Marion 161kV electrical transmission line, county roads, section lines, and parcel boundaries to the extent practicable.
- Portions of the Applicant Proposed Route are outside the 1-mile-wide area of Links M-2 and M-5 of the Network of Potential Routes presented at the public scoping meetings for the EIS. In Link M-2, the Clean Line Routing Team identified a route that more closely follows Entergy Arkansas Inc.'s Marked Tree-to-Marion 161kV electric transmission line. In Link M-5, the Clean Line Routing Team identified a route that more closely followed field lines and parcel boundaries and that avoided residential areas identified during aerial reconnaissance.

The Region 7 Applicant Proposed Route is shown on Figure 2.1-17f in Appendix A.

2.4.3 DOE Alternatives

The DOE Alternatives evaluated in this EIS include an intermediate AC/DC converter station in Arkansas and HVDC alternative routes in each region. The regions potentially affected by the alternatives (and the counties within each region) are provided in Table 2.4-1 and are shown in Figures 2.1-17a through 2.1-17f (located in Appendix A). The Arkansas Converter Station Alternative is discussed in Section 2.4.3.1. The HVDC alternative routes are described in Section 2.4.3.2. As identified previously in Section 2.4.2, the Applicant Proposed Route is divided into links, within each region. These links represent sections of the Applicant Proposed Route between points where alternative routes intersect with it. The alternative routes diverge from the Applicant Proposed Route and provide an alternative to the corresponding links of the Applicant Proposed Route. Table 2.4-1 includes information about the links of the Applicant Proposed Route to illustrate their relationship to the alternative routes.

Table 2.4-1:
Counties Potentially Affected by DOE Alternatives

Feature	Length (Miles)	State	Counties
Converter Station			
Arkansas Converter Station Alternative	N/A	Arkansas	Pope or Conway
Arkansas AC Interconnection	6.0	Arkansas	Pope or Conway
HVDC Alternative Routes			
Region 1 (Oklahoma Panhandle)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	1.91	Oklahoma	Texas
Alternative Route 1-A	123.3	Oklahoma	Texas, Beaver, Harper, and Woodward
Corresponding Links (2, 3, 4, 5) of the Applicant Proposed Route	114.0	Oklahoma	Texas, Beaver, Harper, and Woodward
Alternative Route 1-B	52.1	Oklahoma	Texas and Beaver
Corresponding Links (2, 3) of the Applicant Proposed Route	54.0	Oklahoma	Texas and Beaver
Alternative Route 1-C	52.2	Oklahoma	Texas and Beaver
Corresponding Links (2, 3) of the Applicant Proposed Route	54.0	Oklahoma	Texas and Beaver
Alternative Route 1-D	33.6	Oklahoma	Beaver and Harper
Corresponding Links (3, 4) of the Applicant Proposed Route	33.7	Oklahoma	Beaver and Harper
Region 2 (Oklahoma Central Great Plains)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	20.32	Oklahoma	Woodward
Alternative Route 2-A	57.3	Oklahoma	Woodward and Major
Corresponding Link (2) of the Applicant Proposed Route	54.6	Oklahoma	Woodward and Major
Alternative Route 2-B	29.9	Oklahoma	Major and Garfield
Corresponding Link (3) of the Applicant Proposed Route	31.3	Oklahoma	Major and Garfield
Region 3 (Oklahoma Cross Timbers)			
Alternative Route 3-A	37.7	Oklahoma	Garfield, Logan, and Payne
Corresponding Link (1) of the Applicant Proposed Route	40.1	Oklahoma	Garfield, Kingfisher, Logan, and Payne
Alternative Route 3-B	47.9	Oklahoma	Garfield, Logan, and Payne
Corresponding Links (1, 2, 3) of the Applicant Proposed Route	50.1	Oklahoma	Garfield, Kingfisher, Logan, and Payne

Table 2.4-1:
Counties Potentially Affected by DOE Alternatives

Feature	Length (Miles)	State	Counties
Alternative Route 3-C	121.9	Oklahoma	Payne, Lincoln, Creek, Okmulgee, and Muskogee
Corresponding Links (3, 4, 5, 6) of the Applicant Proposed Route	118.9	Oklahoma	Payne, Lincoln, Creek, Okmulgee, and Muskogee
Alternative Route 3-D	39.4	Oklahoma	Muskogee
Corresponding Links (5, 6) of the Applicant Proposed Route	35.2	Oklahoma	Muskogee
Alternative Route 3-E	8.5	Oklahoma	Muskogee
Corresponding Link (6) of the Applicant Proposed Route	7.8	Oklahoma	Muskogee
Region 4 (Arkansas River Valley)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	8.31	Oklahoma	Muskogee
Alternative Route 4-A	58.6	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Corresponding Links (3, 4, 5, 6) of the Applicant Proposed Route	60.6	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Alternative Route 4-B	78.9	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Corresponding Links (2, 3, 4, 5, 6, 7, 8) of the Applicant Proposed Route	81.5	Oklahoma and Arkansas	Sequoyah County, Oklahoma, and Crawford and Franklin counties, Arkansas
Alternative Route 4-C	3.4	Arkansas	Crawford
Corresponding Link (5) of the Applicant Proposed Route	2.2	Arkansas	Crawford
Alternative Route 4-D	25.4	Arkansas	Crawford and Franklin
Corresponding Links (4, 5, 6) of the Applicant Proposed Route	25.4	Arkansas	Crawford and Franklin
Alternative Route 4-E	36.9	Arkansas	Franklin, Johnson, and Pope
Corresponding Links (8, 9) of the Applicant Proposed Route	38.9	Arkansas	Franklin, Johnson, and Pope
Region 5 (Central Arkansas)			
Alternative Route 5-A	12.7	Arkansas	Pope
Corresponding Link (1) of the Applicant Proposed Route	12.3	Arkansas	Pope
Link 2 of the Applicant Proposed Route (no corresponding Alternative Route)	6.45	Arkansas	Pope
Alternative Route 5-B	71.2	Arkansas	Pope, Conway, Faulkner, White
Corresponding Links (3, 4, 5, 6) of the Applicant Proposed Route	67.4	Arkansas	Pope, Conway, Van Buren, Cleburne and White
Alternative Route 5-C	9.2	Arkansas	White
Corresponding Links (6, 7) of the Applicant Proposed Route	9.4	Arkansas	White
Alternative Route 5-D	21.7	Arkansas	White and Jackson
Corresponding Link (9) of the Applicant Proposed Route	20.5	Arkansas	White and Jackson
Link 8 of the Applicant Proposed Route (no corresponding Alternative Route)	1.61	Arkansas	White
Alternative Route 5-E	36.4	Arkansas	Van Buren, Faulkner, and White
Corresponding Links (4, 5, 6) of the Applicant Proposed Route	33.3	Arkansas	Van Buren, Cleburne, and White
Alternative Route 5-F	22.4	Arkansas	Cleburne and White
Corresponding Links (5, 6) of the Applicant Proposed Route	18.8	Arkansas	Cleburne and White

Table 2.4-1:
Counties Potentially Affected by DOE Alternatives

Feature	Length (Miles)	State	Counties
Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)			
Link 1 of the Applicant Proposed Route (no corresponding Alternative Route)	6.12	Arkansas	Jackson
Alternative Route 6-A	16.2	Arkansas	Jackson and Poinsett
Corresponding Links (2, 3, 4) of the Applicant Proposed Route	17.7	Arkansas	Jackson and Poinsett
Alternative Route 6-B	14.1	Arkansas	Jackson and Poinsett
Corresponding Link (3) of the Applicant Proposed Route	9.7	Arkansas	Jackson and Poinsett
Link 5 of the Applicant Proposed Route (no corresponding Alternative Route)	1.87	Arkansas	Poinsett
Alternative Route 6-C	23.2	Arkansas	Poinsett
Corresponding Links (6, 7) of the Applicant Proposed Route	24.9	Arkansas	Poinsett and Cross
Alternative Route 6-D	9.2	Arkansas	Cross and Poinsett
Corresponding Link (7) of the Applicant Proposed Route	8.6	Arkansas	Cross and Poinsett
Link 8 of the Applicant Proposed Route (no corresponding Alternative Route)	3.91	Arkansas	Poinsett
Region 7 (Arkansas Mississippi River Delta and Tennessee)			
Alternative Route 7-A	43.2	Arkansas and Tennessee	Poinsett and Mississippi counties, Arkansas, and Tipton County, Tennessee
Corresponding Link (1) of the Proposed Route	28.7	Arkansas and Tennessee	Poinsett and Mississippi counties, Arkansas, and Tipton County, Tennessee
Link 2 of the Applicant Proposed Route (no corresponding Alternative Route)	1.08	Tennessee	Tipton
Alternative Route 7-B	8.6	Tennessee	Tipton and Shelby
Corresponding Links (3, 4) of the Applicant Proposed Route	8.3	Tennessee	Tipton and Shelby
Alternative Route 7-C	23.8	Tennessee	Tipton and Shelby
Corresponding Links (3, 4, 5) of the Applicant Proposed Route	13.2	Tennessee	Tipton and Shelby
Alternative Route 7-D	6.2	Tennessee	Tipton and Shelby
Corresponding Links (4, 5) of the Applicant Proposed Route	6.6	Tennessee	Tipton and Shelby

2.4.3.1 Arkansas Converter Station

During the scoping period, DOE received comments from stakeholders in Arkansas who were concerned that the state would endure impacts from the Project without receiving any of the benefits (e.g., ability to accept increased amounts of renewable energy, tax revenues from property and ad valorum taxes associated with new facilities, and increased number of jobs). Based on these comments, DOE requested that Clean Line evaluate the feasibility of an alternative that would add a converter station in Arkansas. The Arkansas converter station would be an intermediate converter station; it would not replace the Oklahoma or Tennessee converter stations. Based on Clean Line's feasibility evaluation, an Arkansas converter station could be sited in either Pope County or Conway County, Arkansas. This alternative converter station would be similar to the Oklahoma and Tennessee converter stations, except that it would likely require a smaller land area, encompassing approximately 40 to 50 acres. The facility dimensions and land requirements are summarized in Table 2.4-2. Based on preliminary design and studies, it would be capable of interconnecting 500MW. With the implementation of this alternative, the delivery capability of the Project would be increased to 4,000MW.

The interconnection for the Arkansas converter station would include an approximate 6-mile 500kV AC transmission line (the interconnection requirements are discussed in Section 2.2.1) to an interconnection point along the existing Arkansas Nuclear One-Pleasant Hill 500kV AC transmission line by way of a direct tap or small switchyard. The interconnection facilities would be located within a small switching/tap station of approximately 5 acres in size; this area would be fenced and retained during operations and maintenance of the converter station. An additional 5 acres would be required during construction of the converter station and 500kV AC interconnection for materials staging and equipment storage. Tensioning and pulling sites, wire-splicing sites, and multi-use construction yards would all occur within the AC interconnection siting area. The design and layout of the interconnection facilities are dependent on the results of ongoing interconnection and engineering studies (see Section 2.2.1).

The 500kV AC line would consist of an arrangement of three electrical phases each with a three-conductor bundle (i.e., three subconductors) in a triangle configuration about 18 to 24 inches on each side. Each conductor would be an approximate 1- to 2-inch-diameter aluminum conductor with a steel reinforced core, or a very similar configuration. The Applicant would design minimum conductor height above the terrain, assuming no clearance buffers, per Rule 232D of the NESC, Edition 2012, requiring 29 feet for general areas and vehicular traffic (for a 500kV AC line).

Table 2.4-2:
Arkansas Converter Station Alternative and Associated Facilities Dimensions and Land Requirements

Facility	Construction Dimensions[1]	Operation Dimensions[1]
Arkansas Converter Station Alternative-Pope or Conway County, Arkansas	40 to 50 acres of land would be required, plus an additional 5 to 10 acres for construction.	40 to 50 acres of land would be required for the station; approximately 40 acres would be fenced.
Arkansas Converter Station Access Road	All weather access roads 20 feet wide by less than 1 mile long would be required. Construction of the access roads may disturb an area up to 35 feet wide.	20-foot-wide paved roadways.
ROW	One 500kV ROW 150–200 feet wide x 6 miles long (assumes 6 mile or less long).	One 500kV ROW 150–200 feet wide x approximately 6 miles long.
500kV—Lattice Structures	Structure assembly area, 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile500kV.	Structural footprint 28 feet x 28 feet (typical for lattice structures) 75 to 180 feet tall, 5 to 7 structures per mile.
500kV—Tubular Pole Structures	Structure assembly area 150 feet wide (ROW width) x 150 feet long (within ROW), 5 to 7 structures per mile.	Structural footprint 7 feet x 7 feet (typical for tubular pole structures), 75 to 180 feet tall, 5 to 7 structures per mile.
AC Interconnection Point	500kV AC: a 5-acre site where the alternative AC transmission line would interconnect with an existing 500kV transmission line. An additional 5 acres would be required during construction.	The 5-acre site would be fenced. Permanent access road to the fenced area. Power supply to fenced area.

1 Final design and/or dimensions may differ from typical dimensions expressed here.

Descriptions of ROW easements, structure types, and access for the HVDC alternative routes would be the same as described in Sections 2.1.2.2.1, 2.1.2.2.2, and 2.1.2.4. Construction practices for the HVDC alternative routes or Arkansas converter station alternative would be the same as described in Section 2.1.4. Impacts of these alternatives could nonetheless vary due to differences in affected environment and the scale of the alternatives compared to the

Applicant Proposed Project. The impacts, and variations of impacts from the Applicant Proposed Project, are described in Chapter 3 and summarized in Section 2.6.

2.4.3.2 HVDC Alternative Routes

DOE developed alternative routes as described in Section 2.3.1. These alternatives were discussed and evaluated with Clean Line for feasibility. Eventual selection of a route alignment for the HVDC transmission line could either follow the Applicant Proposed Route for the entire length or could bypass specific links of the Applicant Proposed Route by selecting specific alternative routes.

2.4.3.2.1 Region 1 (Oklahoma Panhandle)

DOE and Clean Line identified four HVDC alternative routes for Region 1. The Region 1 HVDC alternative routes are shown on Figure 2.1-17a in Appendix A:

- 1-A parallels county roads and section lines for the majority of its length and parallels existing transmission lines for some short distances.
- 1-B parallels section lines for the majority of its length.
- 1-C is made up of portions of HVDC Alternative Routes 1-A and 1-B.
- 1-D follows sections lines for the majority of its length.

2.4.3.2.2 Region 2 (Oklahoma Central Great Plains)

DOE and Clean Line identified two HVDC alternative routes for Region 2. The Region 2 HVDC alternative routes are shown on Figure 2.1-17b in Appendix A:

- 2-A parallels OG&E's Woodward-to-Cleo's Corner 345kV electrical transmission line and the Cimarron River floodplain for the majority of its length.
- 2-B parallels section lines and parcel boundaries and OG&E's Cottonwood Creek-to-Enid 138kV transmission line for the majority of its length.

A portion of Proposed Alternative Route 2-B is outside the 1-mile-wide area of Link D-1 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 2-B is outside of the Network of Potential Routes in this area to avoid a private airstrip identified through review of Federal Aviation Administration (FAA) data and aerial imagery.

Additionally, there is only one route option in the western portion of Region 2 because the city of Woodward, the city of Moreland, Boiling Springs State Park, potentially high value lesser prairie-chicken habitat and rough terrain limit the potential opportunities for other route alternatives.

2.4.3.2.3 Region 3 (Oklahoma Cross Timbers)

DOE and Clean Line identified five HVDC alternative routes for Region 3. The Region 3 HVDC alternative routes are shown on Figure 2.1-17c in Appendix A:

- 3-A parallels county roads and parcel boundaries to the extent practicable.
- 3-B parallels parcel boundaries, section lines, and the KAMO Electric Cooperative, Inc. Stillwater-to-Cushing 69kV transmission line to the extent practicable.
- 3-C parallels OG&E's Cushing-to-Bristow 138kV transmission line, roads, section lines and property boundaries to the extent practicable.
- 3-D begins northwest of Boynton and joins HVDC Alternative Route 3-C approximately 1 mile to the southeast.
- 3-E begins north of Warner, Oklahoma.

Portions of HVDC Alternative Routes 3-C and 3-D are outside the 1-mile-wide area of Link F-8 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Routes 3-C and 3-D are sited outside the Network of Potential Routes in response to comments by the Oklahoma Department of Wildlife Conservation (ODWC) regarding the presence of federal grassland conservation easements and potential high-value greater prairie-chicken habitat.

2.4.3.2.4 Region 4 (Arkansas River Valley)

DOE and Clean Line identified five HVDC alternative routes for Region 4. The Region 4 HVDC alternative routes are shown on Figure 2.1-17d in Appendix A:

- 4-A parallels parcel boundaries and the Nicut-to-Brushy Switching Station 69kV transmission line in Crawford County, Arkansas, to the extent practicable.
- 4-B is located partially within the Ozark National Forest in Crawford County, Arkansas.
- 4-C is a short route that parallels parcel lines to the extent practicable in the Van Buren, Arkansas area.
- 4-D is an alternative in the areas of Cedarville, Van Buren, and Mulberry, Arkansas.
- 4-E parallels parcel boundaries and the Dardanelle-to-Ozark 161kV transmission line to the extent practicable.

Portions of HVDC Alternative Route 4-A are outside the 1-mile-wide area of Links G-2 and G-5 of the Network of Potential Routes presented at the public scoping meetings to avoid residences and a municipality (Cedarville, Arkansas).

Portions of HVDC Alternative Route 4-B are outside the 1-mile-wide area of Links G-2 and G-6 of the Network of Potential Routes presented at the public scoping meetings. Alternative Route 4-B was sited outside the Network of Potential Routes in this area to avoid residences and a municipality (Cedarville, Arkansas) and to respond to comments received during scoping that requested an alternative route through the Ozark National Forest. As presented in Section 2.14, DOE has identified HVDC Alternative Route 4-B as a non-preferred alternative.

Portions of HVDC Alternative Route 4-C are outside the 1-mile-wide area of Link G-4 of the Network of Potential Routes presented at the public scoping meetings for the EIS. Alternative Route 4-C was sited outside the Network of Potential Routes in response to comments received by DOE during the EIS scoping period regarding the residential area north of Van Buren.

Portions of HVDC Alternative Route 4-D are outside the 1-mile-wide area of Link G-5 of the Network of Potential Routes presented at the public scoping meetings for the EIS to avoid residences. These residences were identified in comments submitted to DOE during the EIS scoping period and through comments received by Clean Line during Clean Line's stakeholder meetings.

2.4.3.2.5 Region 5 (Central Arkansas)

DOE and Clean Line identified six HVDC alternative routes for Region 5. The Region 5 HVDC alternative routes are shown on Figure 2.1-17e in Appendix A:

- 5-A is a short alternative that provides a route north of Dover, Arkansas.
- 5-B parallels an existing natural gas transmission pipeline, electrical transmission lines, parcel boundaries, and the Entergy Arkansas, Inc.'s Independence-to-Genpower Keo 500kV transmission line to the extent practicable.
- 5-C is a short alternative that provides a route northeast of Letona, Arkansas.
- 5-D parallels the Entergy Arkansas, Inc.'s Independence-to-Genpower Keo 500kV transmission line, parcel boundaries, and natural gas transmission pipelines to the extent practicable.
- 5-E parallels existing transmission lines to the extent practicable through Faulkner County, Arkansas.
- 5-F provides an alternative to the south of Letona, Arkansas.

2.4.3.2.6 Region 6 (Cache River, Crowley's Ridge Area, and St. Francis Channel)

DOE and Clean Line identified four HVDC alternative routes for Region 6. The Region 6 HVDC alternative routes are shown on Figure 2.1-17f in Appendix A:

- 6-A parallels parcel boundaries and roads to the extent practicable to provide a southern alternative river crossing location for the Cache River.
- 6-B parallels parcel boundaries, State Route 14, and existing transmission lines to provide a northern alternative river crossing location for the Cache River.
- 6-C parallels parcel boundaries and local roads to the extent practicable to provide alternative crossing of Crowley's Ridge and the St. Francis-Oak Donnick Floodway.
- 6-D is a short alternative that parallels a levee to the extent practicable to provide an alternative crossing location for the St. Francis-Oak Donnick Floodway.

Portions of HVDC Alternative Route 6-A are outside of the 1-mile-wide area of Link L-4 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 6-A was sited outside the Network of Potential Routes in this area to follow parcel lines and traverse less forested wetlands.

Portions of HVDC Alternative Route 6-B are outside the 1-mile-wide area of Links L-2 and L-3 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 6-B was sited outside the Network of Potential Routes in this area to follow an existing electrical transmission line south of Amagon, Arkansas, and to avoid private airfields, aerial spraying, and agricultural operations in Poinsett County.

2.4.3.2.7 Region 7 (Arkansas Mississippi River Delta and Tennessee)

The Project includes elements (transmission line routes and facilities and the converter station and interconnections) in Tennessee. The EIS includes an impacts and alternatives analysis of all Project components; including those located in Tennessee. As explained in Section 1.1.1, DOE's participation in the Project would be limited to states in which Southwestern operates; namely Oklahoma, Arkansas, and possibly Texas, but not Tennessee.

DOE and Clean Line identified four HVDC alternative routes for Region 7. The Region 7 HVDC alternative routes are shown on Figure 2.1-17f in Appendix A:

- 7-A parallels existing canals, county roads, section lines, parcel boundaries, and field lines to the extent practicable to provide an alternative Mississippi River crossing location to the north. 7-A also parallels TVA's Shelby-to-Sans Souci 500kV transmission line.
- 7-B parallels property lines and local roads to provide an alternative in Tipton County, Tennessee.
- 7-C parallels local roads and TVA's Covington-to-Northeast Gate 161kV transmission line and provides a southern route into the converter station.
- 7-D parallels TVA's Shelby-to-Sans Souci 500kV electrical transmission line and provides a northern route into the converter station.

Portions of HVDC Alternative Route 7-A are outside the 1-mile-wide area of Link M-1 of the Network of Potential Routes presented at the public scoping meetings. HVDC Alternative Route 7-A was sited outside the Network of Potential Routes in this area to avoid a center pivot irrigation system and a perpendicular crossing of an airfield.

Portions of HVDC Alternative Route 7-B are outside the 1-mile-wide area of Link M-5 of the Network of Potential Routes presented at public scoping meetings. This alternative was sited outside the Network of Potential Routes in this area in response to scoping comments that requested the analysis of routes that were south of Millington, Tennessee.

Portions of HVDC Alternative Route 7-C are outside the 1-mile-wide area of Link M-5 of the Network of Potential Routes presented at the public scoping meetings. This alternative was sited outside the Network of Potential Routes in this area in response to comments that requested the analysis of routes south of the Millington Regional Airport that also would avoid Munford, Tipton, and Atoka.

HVDC Alternative HVDC Route 7-D is outside the Network of Potential Routes presented at public scoping meetings. This alternative was sited outside the Network of Potential Routes in this area in response to comments expressing concerns about the existing and planned airspace north of the Millington Regional Airport; this alternative is a greater distance from the airport than the Applicant Proposed Route and follows the TVA Shelby-to-Sans Souci 500kV existing transmission line for portions of its length.

2.4.4 Alternatives Considered but Eliminated from Detailed Analysis

DOE considered several additional potential alternatives, in part based on public scoping comments, but eliminated them from detailed analysis as discussed below.

2.4.4.1 Alternative Transmission Line Routes

During the iterative planning and siting process for the transmission line, a number of route alternatives were proposed and studied. These alternatives were evaluated for their feasibility and ultimately eliminated from further study and consideration based on route-specific factors and public scoping comments. Route alternatives that were studied and eliminated and the rationales for their elimination are discussed in the DOE Alternatives Development Report (DOE 2013). Excerpts from the DOE Alternatives Development Report (including the main body of the report and select appendices; including the Tier IV Routing Study) are provided in Appendix G of this EIS.

2.4.4.2 Underground HVDC Transmission Line

During public scoping, some commenters suggested that the HVDC transmission line be installed underground for either the entire length or for discrete segments to minimize visual impacts associated with construction and operations and maintenance. To date, underground electric transmission cable technology is not commercially available at the very high voltage and capacity levels (i.e., +/- 600kV and 3,500 to 4,000MW) planned for the Project. The highest achieved cable ratings for undergrounding HVDC, thus far, are ±500kV at about 2,000MW (KCC 2013). While there is research underway for underground high-voltage transmission cable technology that could conceivably be applied to the voltage and capacity levels of the Project, this research has yet to produce commercially available, proven technology, and DOE does not foresee that such technology will become available within the time frame for construction of the Project.

In addition, based on current understanding, even if such technology were to become available, other constraints would make it infeasible to install a conductor (i.e., the transmission line) of this voltage and capacity underground. Such conductors cannot be directly buried. They must be mechanically protected by being installed within a buried duct bank, conduit, or tunnel. Frequent access points would be required from the surface into these duct banks, conduits, or tunnels to allow for splicing, monitoring, and maintenance. Heat dissipation from the underground conductors would be a significant challenge to the installation. Also, the large insulation requirements would result in extreme weights for an underground conductor relative to an overhead conductor, so only short segments could be installed at any one time, significantly increasing the cost and time required for completing the construction. The diagnosis and repair of outages could be time-consuming, which would affect emergency response times, could result in additional ground disturbance and excavation to locate and repair the problems.

Based on this analysis, DOE concluded that undergrounding all or portions of the Project is not a reasonable alternative and has eliminated it from further analysis.

2.4.4.3 Local Generation and Distribution

During public scoping, commenters suggested utilizing distributed generation as an alternative to the Applicant Proposed Project. Distributed generation involves the use of small-scale power generation technologies that are usually installed at or near the location to the load being served by the generated power. Distributed generation does not require long-range transmission lines. Distributed generation systems range in size from approximately 5 kilowatts to 10MW, in contrast to utility-scale generation that ranges from 10MW to more than 1,000MW per site. Examples of distributed generation resource technologies include residential and roof-top photovoltaic, energy storage devices, microturbines, and fuel cells.

This alternative was eliminated from further analysis because Section 1222 of the EPAct does not authorize the Secretary of Energy to participate with other entities in distributed generation, and the alternative does not meet the DOE-issued RFP for new or upgraded transmission projects. As such, the alternative would not meet the purpose and need for agency action because distributed generation as studied by DOE does not meet the utility-scale generation required. DOE has determined that distributed generation would not meet the need of utility-scale generation and would still require the Project to meet the needs of the agency's goal. DOE has established policies and programs related to distributed generation (http://www.energy.gov/eere/wipo/renewable-energy-distributed-generation-policies-and-programs).

2.4.4.4 Energy Conservation Programs

During public scoping, commenters suggested energy conservation programs as an alternative to the Applicant Proposed Project. Commenters suggested that mandatory conservation and demand response programs be used to eliminate the need for more generation and transmission. This alternative would include regulated energy use at the consumer level to decrease the overall energy demand. This alternative was eliminated from detailed consideration because Section 1222 of the EPAct does not authorize the Secretary of Energy to participate with other entities in energy conservation programs. As such, the alternative would not meet the purpose and need for agency action because energy conservation programs, as studied by DOE, would not meet the utility-scale generation required. DOE has determined that energy conservation programs would not meet the need of utility-scale generation and would still require the Project to meet the needs of the agency's goal. DOE has established policies and programs related to energy conservation programs (http://www.energy.gov/eere/efficiency).

2.5 Connected Actions

Connected actions are those that are "closely related" to the proposal. Actions are considered connected if they automatically trigger other actions which may require environmental impact statements, cannot or will not proceed unless other actions have been taken previously or simultaneously, or are interdependent parts of a larger action and depend on the larger action for their justification (40 CFR 1508.25). Connected actions are analyzed together with the Applicant Proposed Project and DOE Alternatives in this EIS.

2.5.1 Wind Energy Generation

The construction and operations and maintenance of reasonably foreseeable wind power facilities are evaluated as connected actions in the Plains & Eastern EIS. Wind power facilities that would interconnect with the Project are anticipated to be located in parts of the Oklahoma Panhandle and Texas Panhandle within an approximate 40-mile radius of the western converter station. As identified in Section 2.1.2.3, the Applicant based the 40-mile radius assumption on preliminary studies of engineering constraints and wind resource data, industry knowledge, and economic feasibility. The Applicant anticipates that these wind energy generators will be the primary customers using the transmission capacity of the Plains & Eastern transmission line. To achieve full utilization of the 3,500MW delivery capacity of the Applicant Proposed Project, the Applicant anticipates actual wind farm build-out to be approximately 4,000MW. With the addition of the Arkansas converter station alternative, the Applicant anticipates the delivery capacity of the Project to increase to 4,000MW, and associated wind farm build-out to be approximately 4,550MW (Clean Line 2014b). The Oklahoma Panhandle region contains an excellent wind resource (DOE 2011) and the Applicant has determined that adequate electrical interconnection facilities are available to support a new converter station are present in this region. An analysis of the wind resource in Oklahoma's Panhandle region by the

National Renewable Energy Laboratory shows that large areas of wind resources with average annual wind speeds greater than 8 meters/second are prevalent in that part of the state (NREL 2011).

Neither the Applicant nor DOE knows the exact location of wind power facilities that would be connected to the Project. However, it is reasonably foreseeable that future wind farms would be located in a reasonable proximity to the Project's Oklahoma converter station and in areas with high wind resource potential and suitable land use(s). This EIS provides an analysis of potential impacts from wind development within an area of an approximate 40-mile radius of the Oklahoma converter station. Clean Line identified 12 Wind Development Zones (WDZs) in its *Wind Generation Technical Report* (Clean Line 2014b) based on available wind resources and existing land uses within the 40-mile radius. Table 2.5-1 presents the size and potential maximum generation capacity for each WDZ analyzed in this EIS for potential wind energy generation. Figures 2.1-2 and 2.1-17a in Appendix A provide illustrations of the WDZs in relation to the locations of the various Project components.

Table 2.5-1:
Size and Potential Maximum Generation Capacity of Wind Development Zones

WDZ	Approximate Total Size (acres)	Potentially Suitable Areas for Wind Development (acres)	Approximate Maximum Wind Development (megawatts)
A	109,000	101,000	800
B	125,000	108,000	900
C	160,000	123,000	1,000
D	69,000	43,000	300
E	47,000	43,000	300
F	112,000	82,000	700
G	186,000	159,000	1,300
H	116,000	67,000	500
I	105,000	85,000	700
J	92,000	44,000	400
K	92,000	84,000	700
L	165,000	144,000	1,200

Where construction and operations and maintenance of individual wind power facilities require permits or authorizations, site-specific environmental review, possibly including NEPA review, may be conducted prior to the construction and operations and maintenance of individual wind farm projects.

2.5.2 Related Substation and Transmission Upgrades

In addition to the transmission lines and related facilities analyzed as part of the Project, the EIS also analyzes facility additions and upgrades to existing third-party transmission systems that would be required to enable the Project to transmit power. The additions and upgrades in Oklahoma and Tennessee are evaluated as connected actions in the EIS. No transmission network upgrades would be required to accommodate the interconnection in Arkansas.

Oklahoma

The Applicant Proposed Project includes construction and operations and maintenance of a converter station in Texas County, Oklahoma. The Oklahoma converter station would be interconnected to the existing transmission system. This interconnection is necessary to enable the AC to DC conversion process within the Oklahoma converter station. The interconnection between the proposed Oklahoma converter station and the SPS system would be controlled to a nominal value of zero (0) MW; meaning that there would be no net energy exchange. Based on the SPS analysis completed to date, the Applicant expects that a new substation would be necessary to accommodate the interconnection due to space constraints at the existing 345kV Hitchland Substation. To alleviate these space constraints, SPS has proposed a new substation nearby, tentatively named "Optima." This new substation, which represents the connected action, would be located within a few miles of the Oklahoma converter station in Texas County, Oklahoma, within the area identified on Figure 2.1-3 in Appendix A as the AC Interconnection Siting Area. Additional background and details are provided in Section 2.2.1.1.

Arkansas

A DOE Alternative would include construction and operations and maintenance of an intermediate converter station in Arkansas to enable injection and delivery of up to 500MW of power into the Arkansas electrical grid. Clean Line selected the Arkansas Nuclear One–Pleasant Hill 500kV Point of Interconnection. The Midcontinent Independent System Operator (MISO) performed a feasibility study of the request and concluded in February 2014 that no network upgrades were required to accommodate the interconnection (MISO 2014). No connected actions would therefore be associated with substation or transmission upgrades in Arkansas.

Tennessee

The Applicant Proposed Project includes construction and operations and maintenance of a converter station in either Shelby or Tipton County, Tennessee to enable injection of up to 3500MW of power into the Shelby Substation. As described in Section 2.2.1.3, TVA completed its Interconnection SIS to determine whether any upgrades (or modifications) to its transmission system would be necessary to protect grid reliability while accommodating Clean Line's request for interconnection at 3500MW.

TVA's Interconnection SIS has identified the following connected actions as necessary to enable the injection of 3500MW from the Plains & Eastern Clean Line: (a) upgrades to existing infrastructure and (b) construction of a new 500kV AC transmission line, approximately 37 miles long, in western Tennessee, including necessary modifications to existing substations on the terminal ends of the new line. Upgrades to existing infrastructure would include upgrading terminal equipment at three existing 500kV substations and three existing 161kV substations; making appropriate upgrades[4] to increase heights on 16 existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines.

TVA's Interconnection SIS estimates that completion of all upgrades would take 8 years to complete after TVA completes the Facilities Study. TVA anticipates tiering from this EIS when completing its review of potential environmental impacts as required by NEPA. TVA would evaluate both upgrades to existing infrastructure and construction of a new 500kV transmission line under their NEPA procedures. It is likely that upgrades to existing infrastructure would fall under categories of actions that are expected to result in few, if any, environmental impacts. TVA would likely evaluate potential impacts associated with construction and operations and maintenance of a new 500kV AC transmission line under a separate NEPA review once the location and design have been identified. For this reason, and because specific route information is not available, the new transmission line is not analyzed in detail in this EIS, but is discussed qualitatively in the connected action section in Chapter 3 for each resource.

[4] Most upgrades to existing transmission lines would occur in central and western Tennessee.

The total length of multiple existing transmission lines that could require some degree of upgrade is approximately 350 miles; most of these lines are located in central and western Tennessee. However, the upgrades would likely not be necessary along the full length of each line; i.e., the total length of existing transmission lines requiring modification would be less than 350 miles. The detailed identification of the necessary upgrades to each transmission line and construction of a new transmission line (as discussed above) is the subject of an interconnection facilities study begun by TVA in 2014 and anticipated to be completed in mid-2016. More detail regarding the typical upgrade activities is provided below.

This EIS assumes that impacts to resources would not occur where the existing terminal equipment at substations would be upgraded; these existing substations are assumed to have permanent access roads that would be used for upgrades, and upgrade activities would not increase the overall footprints of disturbance. The EIS evaluates the following likely upgrades to existing transmission lines:

1. Removing physical objects that interfere with line clearance
2. Replacing and/or modifying existing structures to increase clearance
3. Installing intermediate structures
4. Replacing the existing conductor with another that can accommodate higher power flows
5. Modifying the existing conductor to increase ground clearance
6. Adding fill rock or dirt around the base of existing structures
7. Working with the local power companies to modify their lines where they cross under TVA's lines

The various modification/upgrade activities are described in more detail below.

Typical modifications to existing conductors, installations of intermediate structures, additions of structure extensions, or replacements of existing structures are performed with standard transmission line construction and maintenance equipment such as crane trucks, bulldozers, bucket or boom trucks, and forklifts. Disturbance is usually limited to an approximate 100-foot radius around a transmission line structure.

Modifications to existing conductors include: conductor slides, cuts, and/or installation of floating deadends to increase ground clearance by increasing the height of conductor where it sags to its minimum clearance, or "belly," between structures. A slide involves relocating the conductor clamp on the adjacent structure a certain distance toward the area of concern (i.e., "sliding" the clamp). A cut involves cutting the conductor, removing a small piece of it, and then splicing the conductor ends back together. A floating deadend shortens the vertical (or "suspension") insulator string that attaches a conductor to a "suspension" (or "tangent") structure to raise the height of its conductor. A suspension structure is one that is designed to provide primarily vertical support for a conductor, but not to take the full tension of the conductor, which would require that the structure also provide significant horizontal support.

If the existing conductor is not rated to carry the new electrical load required for the transmission line, the conductor must be replaced. Reels of replacement conductor are delivered to various staging areas along the transmission line ROW and temporary H-frame clearance poles are installed at road crossings to reduce interference with traffic. Bucket trucks are utilized for worker access to the insulators supporting the conductors. Pulleys are attached to the insulators at the conductor clamp points. The new conductor is connected to the old conductor and pulled down the line through the pulleys. A bulldozer and specialized tensioning equipment is used to pull conductors to the proper tension. Workers then clamp the wires to the insulators and remove the pulleys. The length of continuous conductor wire replaced in a single "pull" varies and is limited to a maximum of 5 miles. Pull point locations depend on the type of structures supporting the conductor as well as the length of conductor being installed. Pull points are typically located along the most accessible path on the ROW (adjacent to road crossings or existing access roads). The area of disturbance at each pull point typically ranges from 200 to 300 feet along the line ROW.

Rock or soil "surcharge" is sometimes added to the base of a transmission structure when height and/or loading modifications are made to the structure. These modifications can create uplift on the structure foundation, therefore requiring the surcharge to maintain structure stability, particularly during inclement weather conditions or high conductor loading. The surcharge is typically delivered to structures by dump trucks and placed around the structure base using tracked equipment. Ground disturbance is typically limited to the immediate vicinity of the structure.

Transmission line upgrade activities are planned in a manner to maximize the use of existing access roads and to avoid non-essential stream crossings and activities in wetlands. Other sensitive environmental resources are also avoided to the extent practicable. Where necessary, standard erosion control measures such as the installation of silt fences are implemented. After the completion of the activity, the disturbed area is revegetated using native or non-invasive, low-growing plant species in appropriate areas. Areas such as pastures, agricultural fields, and lawns are restored to their former condition.

2.6 Summary of Impacts by Resource

The impacts analyzed in Chapter 3 of this EIS are summarized in Tables 2.6-1, 2.6-2, and 2.6-3. Table 2.6-1 provides a summary of potential environmental impacts from construction and operations of the proposed converter stations, including the Arkansas Converter Station Alternative Siting Area and AC interconnection. Table 2.6-2 provides a summary of the potential environmental impacts of construction and operations of the AC collection system. These impacts are provided as a range of impacts that could occur among the thirteen different AC collection system routes. Table 2.6-3 provides a summary of the potential environmental impacts of construction and operations of the HVDC transmission line, including any specific difference in impacts between the Applicant Proposed Route and the HVDC alternative routes. Unless specifically identified, potential impacts would be expected to be similar for the Applicant Proposed Route and the HVDC alternative routes.

Chapter 3 also provides the potential environmental impacts for each resource area that could occur from decommissioning of the Project components. Generally, the impacts of decommissioning the Project would be similar to those presented for construction. The Applicant would follow the same general and resource-specific EPMs during decommissioning that would be implemented during construction. In addition, the Applicant would develop a Decommissioning Plan prior to any decommissioning actions for review and approval by the applicable state and federal agencies.

Impacts are presented for the following resource categories: Agriculture; Air Quality and Climate Change; Electrical Environment; Environmental Justice; Geology, Paleontology, Minerals, and Soils; Groundwater; Health, Safety, and Intentional Destructive Acts; Historic and Cultural Resources; Land Use; Noise; Recreation; Socioeconomics; Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species; Surface Water; Transportation; Vegetation Communities and Special Status Plant Species; Visual Resources; Wetlands, Floodplains, and Riparian Areas; and Wildlife and Fish.

Impacts in the table are presented in terms of direct, indirect, temporary, short-term, long-term, and permanent impacts for each resource area. Direct impacts occur at the same time and place as the Project. Indirect impacts are effects that may occur later in time, or further away from the Project, but are still reasonably foreseeable. Impacts are also characterized by time frame: temporary, short-term, long-term, or permanent. Temporary impacts would occur during construction, with the resource returning to preconstruction conditions once construction is complete. Short-term impacts would continue beyond the completion of construction and last from 2 to 5 years, depending on the resource affected. Long-term impacts would last beyond 5 years and could extend for the life of the Project; these impacts pertain to resources requiring longer recovery periods to return to preconstruction conditions. Permanent impacts are those that would be expected to continue even after decommissioning of the Project.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
AGRICULTURAL RESOURCES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma converter station would be located on undeveloped rangeland; approximately 94.8% of the land cover in the siting area is grassland/herbaceous. Construction of the converter station would convert 45 to 60 acres of rangeland to an industrial land use. During construction, an additional 5 to 10 acres would be used as temporary laydown areas for equipment. An additional 4.24 acres of rangeland would be converted to access roads (2.42 acres long term, 1.82 acres temporary). The Oklahoma AC interconnection would be approximately 2.7 miles long. The agricultural land cover in the representative ROW is currently composed of 58 acres of grasslands. Work in the ROW would include assembly of transmission structures, wire splicing, and tensioning and pulling. Outside the ROW, two additional tensioning and pulling sites of (2.58 acres each, for a total of 5.16 acres) and approximately 25 acres of multi-use construction yards would be required. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Operations and Maintenance Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnection pole structures, and a 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced. Within the AC interconnection ROW (200 feet wide), only the transmission structures would remain with a total footprint of up to less than 1 acre. All other land in the ROW could be returned to previous land uses, primarily grazing. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The land cover in the Tennessee Converter Station Siting Area is approximately 80.1% agricultural land cover (53.6% cultivated crops and 26.5% pasture/hay). No center-pivot irrigation or other irrigation infrastructure is known to occur. Although the exact location has not yet been determined, construction of this converter station would convert 45 to 60 acres of currently undeveloped land to an industrial land use. During construction, an additional 5 to 10 acres would be used as temporary laydown areas for equipment. An additional 4.24 acres of rangeland would be converted to access roads (2.42 acres long term, 1.82 acres temporary). The Tennessee AC interconnection would be located entirely within the Tennessee Converter Station Siting Area and would be approximately 0.20 mile long. During construction, work in the representative ROW would convert approximately 5 acres of primarily cultivated crops and pasture/hay to an industrial use. Work in the representative ROW would include assembly of transmission structures, wire splicing, and tensioning and pulling. Outside the representative ROW, two additional tensioning and pulling sites (2.58 acres each, for a total of 5.16 acres) and approximately 25 acres of multi-use construction yards would be required. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	Operations and Maintenance Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnection transmission structures, and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. Approximately 45 acres would be fenced. Within the AC interconnection siting area ROW (200 feet wide), only the transmission structures would remain with a total footprint of less than 0.02 acre. All other land in the ROW could be returned to previous land uses, primarily cultivated crops and pasture/hay. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The land cover in the Arkansas Converter Station Alternative Siting Area is composed of approximately 4,563.4 acres (20.9%) pasture/hay, approximately 701.2 acres (3.2%) grassland/herbaceous land, and approximately 19.6 acres (0.1%) cultivated crops. The Arkansas AC interconnection would be approximately 6 miles long, and during construction, approximately 146.5 acres of currently primarily pasture/hay land cover would be temporarily converted to an industrial use. Construction of the converter station and AC interconnection would directly affect livestock grazing by temporarily reducing forage and/or displacing livestock in up to approximately 175 acres of land. If any crop land is in the construction area, crops grown in these areas would be lost and crops in adjacent areas may have reduced yields if there are disturbances to irrigation structures or in aerial spraying. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Operations and Maintenance Once construction has been completed, only the 40- to 50-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 40 acres would be fenced. A 5-acre site where the alternative AC transmission line would interconnect with the existing 500kV transmission line would also remain as an industrial use. Although most of this land is not currently used for agricultural purposes, up to 20.9% is used as pasture/hay, 3.2% is grassland/herbaceous, and 0.1% is cultivated crops. If any of these lands are used for long-term structures, they would be removed from agricultural use until decommissioning. Within the Arkansas AC interconnection (200 feet wide by 6 miles long), only the transmission structures and most access roads would remain. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions.
AIR QUALITY AND CLIMATE CHANGE	
All Converter Stations and AC Interconnections	Construction Emissions for constructing each of the converter stations and AC interconnections are estimated to be approximately the same because the converter station sizes and construction processes are similar. While there would be minor temporary impacts on air quality in the vicinity of ongoing construction activities, emissions would be below National Ambient Air Quality Standards for all emissions. Operations and Maintenance The converter stations and AC interconnection would emit negligible air pollutants. Standard operations and maintenance of the converter stations and AC interconnection would not emit air pollutants, but maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
ELECTRICAL ENVIRONMENT	
All Converter Stations	Construction There would be no electrical effects associated with construction of the converter stations, because these facilities would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Operations and Maintenance For the converter stations, the dominant sources of electrical effects would be the AC interconnections. Some types of substation and switching station equipment can potentially be a source of electrical effects (e.g., power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods, so the dominant sources of electrical effects are associated with the overhead transmission lines.
All AC Interconnections	Construction No electrical effects would be associated with construction of AC interconnections because these facilities would not be energized during construction. Oklahoma Converter Station AC Interconnection For the Oklahoma converter station AC interconnection, calculated AC electric fields would be below public guidelines at the ROW edges. However, for one of the three possible configurations (i.e., the double circuit Danube configuration), calculated electric fields at the ROW edge are above guidelines for workers with implanted medical devices. While a variety of electronic devices are known to affect the operation of pacemakers and other implanted medical devices, transmission lines have not been reported as a significant source to produce functional disturbances to these devices. The consequences of brief reversible pacemaker malfunction are mostly benign (typically the implanted device will resume a normal mode of operation if the patient moves away from the source of the interference). An exception would be an individual who has a sensitive pacer and depends on it completely for maintaining all cardiac rhythms. For such an individual, a malfunction that compromised pacemaker output or prevented the unit from reverting to the fixed pacing mode, even brief periods of interference, could be life-threatening. The precise coincidence of events (i.e., pacer model, field characteristics, biological need for full function pacing, and occupation involving work under transmission lines) would generally appear to be a rare event. Since no loading would be present, no AC magnetic field would be generated as a result of the transmission line. Calculated audible noise would be below the public guideline at the ROW edges for two of three possible configuration types (the other configuration type—double circuit monopole— is slightly higher than the public guideline). Calculated radio noise would below guidelines at which reception quality may be less than satisfactory during fair but not rainy weather conditions. While it is difficult to determine whether the TV noise level produced by a transmission line would cause unacceptable interference, new digital broadcast system technology would provide better coverage and immunity to transmission line noise than analog television signals. Maximum ozone levels would be far below the EPA standard. Tennessee Converter Station AC Interconnection For the Tennessee converter station AC interconnection, calculated AC electric fields would be below public guidelines at the ROW edges and within the ROW. However, for the lattice configuration, calculated electric fields at the ROW edge would be above guidelines for workers with implanted medical devices if the ROW width is 150 feet (but would comply where the ROW width is 200 feet). Calculated AC magnetic fields would be below public guidelines in the ROW for all configurations. Calculated audible noise would be above the public guideline at the ROW edges for all configurations. Calculated radio noise is below Federal Communications Commission and Institute of Electrical and Electronic Engineers exposure guidelines during fair but not rainy weather conditions. While it is difficult to determine whether the TV noise level produced by a transmission line would cause unacceptable interference, new digital broadcast system technology should provide better coverage and immunity to transmission line noise than analog television signals. Maximum ozone levels would be far below the EPA standard. Arkansas Converter Station Alternative AC Interconnection For the Arkansas converter station AC interconnection, calculated AC electric fields would be below public guidelines at the ROW edges. However, for the lattice configuration, calculated electric fields within the ROW would be slightly above the transmission line ROW guidelines. For all configurations, calculated electric fields would exceed the guidelines for workers with implanted medical devices within the ROW and at most ROW edges. Calculated AC magnetic fields would be below public guidelines at the ROW edges for both configurations, as well

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	as within the ROW for workers with implanted medical devices. Calculated audible noise would be at or above public guidelines at the ROW edges for both configurations. Calculated radio noise would be below Federal Communications Commission and Institute of Electrical and Electronic Engineers exposure guidelines during fair but not rainy weather conditions. While it is difficult to determine whether the TV noise level produced by a transmission line would cause unacceptable interference, new digital broadcast system technology should provide better coverage and immunity to transmission line noise than analog television signals. Maximum ozone levels would be far below the EPA standard.
ENVIRONMENTAL JUSTICE	
All Converter Stations	Construction/Operations and Maintenance There would be no impacts to areas where no minority or low-income populations were identified. For areas where minority and/or low-income populations were identified, it is expected that any impacts would affect all populations equally.
GEOLOGY, PALEONTOLOGY, SOILS, AND MINERALS	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Subsidence from karst is a possible geologic hazard of concern within the Oklahoma Converter Station Siting Area. Implementation of EPMs and appropriate engineering design, including geotechnical investigations, would avoid or minimize the potential impacts from karst. No known fossil bed sites were identified in the Oklahoma Converter Station Siting Area. About 40% of the siting area is located in the shallow bedrock, so grading and excavation activities could cause direct impacts to paleontological resources if fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Designated Farmland. Eight% (73 acres) of the Oklahoma AC interconnection siting area consists of prime farmland. Depending on the specific siting of the AC interconnection line within this area, impacts could include exposing prime farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil. Soil Limitations. All of the soils within the Oklahoma Converter Station and AC Interconnection Siting Areas would be susceptible to compaction and have moderate to high wind erosion potential. Bedrock or other restrictive layers are encountered within 60 inches of the ground surface in 42% of the Oklahoma converter station siting area and in 50% of the AC interconnection representative ROW. Soil Contamination. No areas of potential soil contamination were identified; therefore, no construction-related impacts are anticipated. Operations and Maintenance Impacts from geological hazards or to mineral resources are not anticipated because the area is located in an area of low seismic risk, soil liquefaction risk is expected to be low, and no mineral resources are located within the siting areas. Operation and maintenance of the converter station would have long-term and potential permanent impacts (lack of access to potential mineral resources) to a 45-acre fenced area and a conservative estimate of 2.4 acres associated with a new paved access road. Additional impacts to 65 acres of land would occur from the AC interconnection line ROW. Transmission structures would impact a conservative estimate of 0.4 acre.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The Tennessee converter station and AC interconnection would be constructed to withstand probable seismic events in the moderate to high seismic hazard zones. Soils within the Tennessee Converter Station Siting Area have high liquefaction potential, which could contribute to unstable conditions and potential structural damage during seismic events. Appropriate placement and design of Project components following completion of geologic/geotechnical investigations during engineering design would minimize risks related to soil liquefaction. The Applicant would implement EPMs to minimize the direct effects of landslides in this area of moderate susceptibility and low incidence. About 30% of the siting area is located in shallow bedrock, and blasting may be required. Impacts would be minimized by appropriate engineering design and through implementation of the Blasting Plan. Designated Farmland. Sixty-two percent (459 acres) of the siting area consists of designated farmland. Depending on the specific siting of the converter station and AC interconnection line within this area, impacts could

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	include exposing prime farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil. Soil Limitations. Soils susceptible to compaction and water erosion dominate the Tennessee siting area. The siting area includes 77 acres (10%) of land with steep slopes and 161 acres (22%) of land with hydric soils. Depending on the specific siting of the converter station, these areas could be avoided or impacted during construction activities. Construction could expose erosion-prone soils to conditions of increased erosion potential; and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Soil Contamination. One National Pollutant Discharge Elimination System (NPDES) site and one Toxics Release Inventory (TRI) site were identified in the siting area. The NPDES site indicates a stone and gravel operation where a permit was granted in 2008 for the discharge of stormwater. The TRI site is the 500kV Shelby Substation. These sites indicate a records inventory and do not raise a concern at this time in regards to areas of soil contamination. Operations and Maintenance The Project components would be operated and maintained in an area of moderate to high seismic hazard, and expected ground motions from an earthquake would be moderate to high. The Project components would be constructed to withstand probable seismic events and constructed in accordance with applicable federal and state regulations to prevent accidents and to ensure adequate protection for the public and the Project. Soils within the siting areas have high liquefaction potential. Geotechnical investigations would be completed in these areas during engineering design. Soils within the siting areas have high liquefaction potential. Geotechnical investigations would be completed in these areas during engineering design. The placement of Project components would be governed in part by site conditions, construction requirements, and EPMs, which would minimize risks related to soil liquefaction. Operations and maintenance would have long-term and potentially permanent impacts (lack of access to potential mineral resources) to a 45-acre fenced area and a conservative estimate of 2.4 acres would be associated with a new paved access road. Transmission structures would impact a conservative estimate of 0.1 acre. The Tennessee converter station may irreversibly convert prime farmland in the Shelby and Tipton counties portions of the Project.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The converter station and AC interconnection would be located in an area of low to moderate seismic hazard, and one active surface fault that traverses the siting area. Soils have high liquefaction potential and about 60% of the soils within the AC interconnection have high liquefaction potential. To reduce impacts from seismic hazard and liquefaction, the Applicant would implement the same measures as described for the Tennessee Converter Station and AC Interconnection Siting Areas. The areas have moderate susceptibility and low incidence with respect to landslides. Potential landslide impacts would be reduced or mitigated using the same techniques as described for the Tennessee Converter Station and AC Interconnection Siting Areas. Impacts from blasting would be minimized by following provisions of the Blasting Plan, and the Applicant would train personnel in the practices, techniques, and protocols required by federal and state regulations and applicable permits to protect potential paleontological resources from grading and excavation activities. Designated Farmland. The converter station siting area is located within 8,197 acres of designated farmland, and the AC interconnection siting area within 9,624 acres of designated farmland. The converter station would require 40 to 60 acres of land. The AC interconnection representative ROW includes 146 acres, 105 acres (or 72%) within designated farmland. Depending on the specific siting of the converter station and AC interconnect line within these areas, impacts could include exposing designated farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil. Soil Limitations. Twenty-seven percent of the Arkansas Converter Station Alternative Siting Area is within lands with steep slopes (15 to 30 %). Soils with moderate to high wind and water erosion potential compose 46 and 10%, respectively, of siting area. Bedrock or other restrictive layers are encountered within 60 inches of the ground surface for 82% of the siting area. Seventeen percent (25 acres) of the AC Interconnection representative ROW is within lands with steep slopes (15 to 30 %). Soils with moderate to high wind and water erosion potential compose 16 and 36%, respectively, of the

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	AC interconnection representative ROW. Bedrock or other restrictive layers are encountered within 60 inches of the ground surface for 73% of the AC interconnection representative ROW. Soil Contamination. Five sites were identified in the Arkansas Converter Station Alternative AC Interconnection Siting Area. All are private farmstead or ranch locations. Implementation of EPMs would minimize potential contamination of soils. Operations and Maintenance The area has moderate susceptibility and low incidence with respect to landslides. The Project components would be in an area of low to moderate seismic hazard. The soils within the siting areas have high liquefaction potential. Impacts from seismic hazards and liquefaction would be minimized utilizing the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Siting Area. The converter station site would permanently impact (lack of access to potential mineral resources) 40 acres of fenced land and 2.4 acres for the paved access road and could take about 22 acres of designated farmland out of production. The AC transmission line ROW is estimated to impact 146 acres of land. Transmission line structures are conservatively estimated to permanently impact 0.6 acres of land.
GROUNDWATER	
All converter station siting areas	Construction Common impacts from all converter stations include (1) potential for contamination from spills or leaks of fuels and lubricants, (2) small and short-term changes in infiltration rates in areas of land disturbance, (3) minor impacts to water availability from water demands, and (4) potential damage to wells and associated piping systems in construction areas.
Oklahoma Converter Station and AC Interconnection Siting Areas	Oklahoma Converter Station No groundwaters of special interest are underneath the Oklahoma Converter Station Siting Area or the associated AC interconnection. No wells or wellhead protection area are located within the station siting area and a single industrial well, which would likely be avoided, is within the ROW of the AC interconnection. Construction would not include work below the water table. Water needed to support construction would likely come from groundwater. Water demand would not be expected to have an impact on the availability of groundwater for other uses. Operations and Maintenance No impacts on groundwater are expected.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The converter station and the AC interconnection line would not be located in an area with designations of special interest. No wellhead protection area or wells occur within the siting areas. Water to support construction would be expected to come from groundwater. Construction of the converter station would not likely encounter groundwater, but transmission line structures might. Operations and Maintenance No impacts on groundwater are expected.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The Arkansas converter station alternative and AC interconnection siting areas would be located over an area that has no principal aquifer. No wellhead protection area or wells are present in the siting areas. Water to support construction would likely not come from groundwater because surface water is the predominant source of water in both Pope and Conway counties. Construction actions could possibly encounter groundwater. Operations and Maintenance No impacts on groundwater are expected.
HEALTH, SAFETY, AND INTENTIONAL DESTRUCTIVE ACTS	
All Project Components	Construction/Operations and Maintenance The Project would introduce hazards that could affect worker and public health and safety. Natural events, external events or accidents (e.g., aircraft mishaps or fires) or intentional destructive acts or mischief could impact such infrastructure and have related effects on the health and safety of construction workers and the public. The Project would involve the transportation and handling of hazardous materials. The implementation of EPMs associated with management of hazardous materials would keep risks to a minimum.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
HISTORIC AND CULTURAL RESOURCES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma Converter Station and AC Interconnection Siting Areas contain no previously recorded archaeological sites or other historic properties. Cultural resources surveys would be performed prior to construction of the Project to ascertain whether any unrecorded eligible properties for listing on the NRHP are present and to assess the possible impacts of construction on such resources if present. DOE intends to establish the timing and protocols for cultural resources surveys in a programmatic agreement. Operations and Maintenance No impacts have been identified.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Same as Oklahoma Converter Station and AC Interconnection Siting Areas (row above). Operations and Maintenance No impacts have been identified.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The Arkansas Converter Station Alternative and AC Interconnection Siting Areas contain 23 previously recorded archaeological sites, including 2 that have been recommended as eligible for the NRHP and 21 that have no eligibility recommendation. There are also three previously recorded historic buildings, none of which has been evaluated for NRHP eligibility. The number of previously recorded cultural resources suggests a moderate to high sensitivity for the presence of sites that may be affected. The Project design would attempt to avoid impacts to NRHP-eligible cultural resources. If avoidance is not possible, appropriate mitigation of adverse impacts to NRHP-eligible cultural resources would be performed in consultation with the appropriate SHPOs and interested Indian Tribes. Operations and Maintenance No impacts have been identified.
LAND USE	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma converter station would be located on undeveloped rangeland; approximately 95% of the land cover in the siting area is grassland/herbaceous. Construction of this converter station would convert 45 to 60 acres of rangeland to a utility land use. The Oklahoma AC interconnection would be approximately 2.7 miles long and would temporarily convert approximately 61 acres of primarily undeveloped rangeland to a utility land use. Operations and Maintenance After construction is complete, only the 45- to 60-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced. Within the 2.7-mile-long AC interconnection ROW, only the transmission structures would remain. All other land in the ROW could return to previous land uses, primarily grazing. Access roads that are not needed for operations and maintenance of the Project would be restored.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The land cover in the Tennessee Converter Station Siting Area is approximately 54% cultivated crops, 27% pasture/hay, and 11% deciduous forest. No center-pivot irrigation or other irrigation infrastructure is known to occur. Although the exact location has not yet been determined, construction of this converter station would convert 45 to 60 acres of this land to a utility land use. Operations and Maintenance After construction is complete, only the 45- to 60-acre converter station, the AC interconnection structures, and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. Approximately 45 acres would be fenced. Access roads that are not needed for operations and maintenance of the Project would be restored.
Arkansas Converter Station Alternative	Construction The land cover in the Arkansas Converter Station Alternative Siting Area consists of evergreen forest (36.1%), deciduous forest (24.8%), and pasture/hay (20.9%). Although the exact location of the converter station has not yet been determined, construction of this converter station would convert 40 to 50 acres of undeveloped land to a utility land use. The Arkansas AC interconnect would be approximately 6 miles long and during construction, approximately 146.5 acres of currently primarily pasture/hay land cover would be temporarily converted to industrial utility land use. Operations and Maintenance After construction is complete, only the 40- to 50-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 40 acres would be fenced. A 5-acre site where the alternative AC transmission line would interconnect with the existing 500kV transmission line would also remain as a utility land use. Within the 6-mile-long Arkansas AC interconnection ROW, only the transmission structures would remain. Access would be restricted during the performance of maintenance activities. Access roads that are not needed for operations and maintenance of the Project would be restored.
NOISE	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Noise levels associated with individual pieces of equipment at 50 feet away would generally range between 55 and 85 dBA maximum sound level (L_{max}). Maximum instantaneous construction noise levels would range from 91 to 95 dBA equivalent sound level (L_{eq}) at 50 feet from any work site. No noise sensitive areas would be located within DOT noise threshold distances, so no exceedances of the DOT guidelines are expected. Operations and Maintenance The predicted sound level at the nearest noise sensitive area would be below the EPA environmental noise guidelines.
Tennessee Converter Station and AC Interconnection Siting Areas	Same as Oklahoma Converter Station and AC Interconnection Siting Areas (row above).
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction Same as Oklahoma Converter Station and AC Interconnection Siting Areas (row above). Operations and Maintenance The predicted sound level at the nearest noise sensitive area would be below the EPA environmental noise guidelines. Six noise sensitive areas (NSAs) would be located within 659 feet of the Arkansas interconnection line, which corresponds to the threshold distance to the 55 dBA L_{dn} EPA guideline threshold for the 500kV single circuit AC transmission line, assuming operating conditions that would generate the highest noise emissions. These six NSAs may experience adverse noise impacts, which are in excess of the EPA guideline threshold. However, impacts would be less under different weather conditions or if the transmission line is located at an altitude less than 3,000 feet.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
RECREATION	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction No impacts to any recreation resources are expected because there are no recreational resources in these areas. Operations and Maintenance No impacts expected.
Tennessee Converter Station	Construction No impacts to any recreation resources are expected because there are no recreational resources in these areas. Operations and Maintenance No impacts expected.
Arkansas Converter Station Alternative	Construction Converter station construction could impact recreational areas if the final location for the converter station is within or adjacent to the Cherokee Wildlife Management Areas (WMA) or the Rainey WMA. Construction could temporarily disturb 45 to 60 acres. Final locations for the converter station have not been determined. It is assumed that the Cherokee and Rainey WMAs would be avoided and the Arkansas Converter Station and AC interconnection would not impact recreation resources. Operations and Maintenance Impacts to recreational areas would only occur if the final location for the converter station is within or adjacent to the Cherokee WMA or the Rainey WMA. The operations and maintenance of the converter station are not expected to permanently preclude the use of or access to any existing recreation areas or activities, although some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit.
SOCIOECONOMICS	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Population and community service impacts would be minor, short term, and temporary. Economic condition impacts would be positive, minor, short term, and temporary. Construction of the converter station is expected to cost approximately $250 million and employ an average of 138 workers over a 32-month construction period, resulting in estimated total employee earnings of $16.2 million. Impacts have the potential to be more substantial in Region 1, where housing resources are more limited, if construction is concurrent with construction of the HVDC transmission line and AC collection system; this potential shortage would be further exacerbated if Project construction coincides with construction of wind projects. Tax revenue impacts would be positive, short term, and temporary from sales, use, and lodging taxes. Operations and Maintenance Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. Annual ad valorem or property tax revenues generated by the Oklahoma converter station would range from $3.2 million to $4.6 million.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Population and community service impacts would be minor, short term, and temporary. Economic conditions impacts would be positive, minor, short term, and temporary. Construction of the converter station is expected to cost approximately $250 million and employ an average of 138 workers over a 32-month construction period, resulting in estimated total employee earnings of $16.2 million. Tax revenue impacts would be positive, short term, and temporary from sales, use, and lodging taxes. Operations and Maintenance Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. In Tennessee, the converter station would result in estimated annual ad valorem tax revenues of $5.6 million and $3.4 million for Shelby and Tipton counties, respectively.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction Same as for Tennessee converter station. Operations and Maintenance Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. Operations and maintenance of the Arkansas converter station would generate annual property or ad valorem tax revenues in either Pope or Conway counties, depending on where it is located. The Arkansas converter station would result in estimated annual ad valorem or property tax revenues of about $0.9 million in either county.
SPECIAL STATUS WILDLIFE AND FISH, AQUATIC INVERTEBRATE, AND AMPHIBIAN SPECIES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction No mortality impacts to any of the special status species are expected. Construction would disturb approximately 45 to 60 acres of grasslands and croplands sat the Oklahoma converter station and associated AC interconnection. The habitat loss is unlikely to have substantial long-term direct impacts to special status wildlife populations in the area. No direct or indirect impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat would occur because no waterbodies are located within the footprint of the converter station. Operations and Maintenance Because the converter station area would be a developed site with approximately 45 acres fenced, the routine presence of staff would not have any impacts to any special status wildlife species. The expected risk of collision mortality from the AC interconnection line to avian species is low. No direct or indirect impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat would occur because no waterbodies are located within the footprint of the converter station.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction No mortality impacts are expected to either the northern long-eared bat or Indiana bat. Potential impacts are expected to be very limited because the siting area is largely croplands and pasture land. No loss of bat habitat is expected so long as construction does not require removal of any potential roost trees that may occur in forested areas. The only special status fish or aquatic invertebrate species identified near the converter station include the pallid sturgeon (federally endangered) and blue sucker (state threatened), which occur within the Mississippi River. Although the Mississippi River is more than 10 miles from the siting area, construction activities could impact tributaries draining into the Mississippi River. If the converter station is built adjacent to Big Creek or Bull Branch. Construction activities could introduce sediment, herbicides, and/or fuel and lubricants into the aquatic system that could travel to the Mississippi River. Operations and Maintenance No impacts to either the northern long-eared bat or Indiana bat are expected. If the converter station is built adjacent to Big Creek or Bull Branch, riparian clearing maintenance, road maintenance activities, and facilities operations could result in increased risk of chemical spills and contamination and increased sedimentation that could travel to the Mississippi River.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The siting areas contain a high proportion of forested habitat that could potentially be used by the Indiana bat and northern long-eared bat for summer-roosting and foraging. The occurrence and use of forested habitat by the northern long-eared bat and Indiana bat, and possibly by the Ozark big-eared bat and gray bat as foraging, within the Project ROI is likely restricted to the spring through fall. To the extent that construction of the converter station and associated AC interconnection transmission lines avoids forested areas, impacts to bat habitat (i.e., removal of roost trees or temporary disturbance of roost sites) would be minimized or avoided. No bald eagle nesting or winter roost sites are known to exist within the siting areas, but any potential sites would be identified prior to construction and appropriate measures would be implemented to avoid potential impact to nests or winter roosts. No direct impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat because no waterbodies are located within the footprint of the construction area or along the interconnection area.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	Operations and Maintenance No impacts to any of the special status bat species are expected from operations and maintenance of the facility. The vegetation in the ROW underneath the AC transmission lines would be maintained in a low stature to prevent interference with electrical conductors. Any trees removed during construction would not be allowed to regrow, including any trees that had been used as bat roost trees. The transmission lines could pose a risk to wintering bald eagles in the region, although there is no suitable habitat within the siting area that would attract eagles from surrounding wintering areas, so the potential risk of collisions with the transmission lines is considered low. No direct or indirect impacts to special status fish, aquatic invertebrate, and amphibian species or their habitat would occur because no major waterbodies are located within the footprint of the construction area or along the interconnection area.
SURFACE WATER	
Common impacts to all converter station and AC interconnection siting areas	Common impacts include (1) potential for runoff and receiving water contamination from spills or leaks of fuels and lubricants, (2) changes in runoff rates in areas of land disturbance, (3) possible disturbance of drainage features, including intermittent or perennial streams, from construction of facilities and access roads; and (4) impacts to water availability from water demands.
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Limited surface water features consisting of 1.6 miles of intermittent stream beds, no perennial streams, and no major waterbodies are present in the siting areas. The length of intermittent streams within the representative 200-foot-wide ROW for the AC interconnection is 0.2 mile. Water needed to support construction would likely not come from surface water. Operations and Maintenance No impacts on surface water are expected.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Limited surface water features consisting of a few drainage features, including 0.25 mile of perennial streams, 4.4 miles of intermittent streams, and no major waterbodies are present within the siting areas. The 200-foot representative ROW for the AC interconnection would encompass no perennial or intermittent streams. Water needed to support the construction would likely not come from surface water. Operations and Maintenance No impacts on surface water are expected.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The siting areas are large with many drainage features, including 12.82 miles of perennial streams and about 57.88 miles of intermittent streams, but no major waterbodies. The 200-foot representative ROW for the AC interconnection would encompass 0.04 mile of perennial streams and 0.3 mile of intermittent streams. The Applicant would avoid surface waters to the extent practicable in selecting the ultimate construction site for the station. Water to support construction of the converter station and interconnection would likely come from surface water; which is expected to be obtained from a municipal provider. Operations and Maintenance No impacts on surface water are expected.
TRANSPORTATION	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction No decrease in level of service is expected for any roadway segments in the siting areas. No railroads are located in the siting areas. No impacts to airports, airstrips, or navigation aids are expected. Operations and Maintenance Negligible impacts to transportation.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Conservative modeling of construction traffic predicts a potential decrease in the level of service from A to B (9 segments) and from B to C (5 segments) for segments of the multiple roadways. Decreases from levels of service LOS-C to LOS-D are predicted for six segments of the some local roadways centered in the area of Munford, Atoka, and Millington, Tennessee. The decrease from LOS-C to LOS-D is only a one-level drop in operation level and would be minimally noticeable to motorists. The scenario that peak traffic would be distributed entirely to the roadway segments with resulting decreases to LOS-D is a worst-case scenario; actual impacts to these roadway segments are expected to be less than predicted. No railroads are located within the siting area. Equipment and buildings associated with the converter station are expected to be less than 85 feet in height; these would not affect nearby airports. Transmission line structures for the AC interconnection are not anticipated to exceed 180 feet and may be subject to FAA review due to their proximity to the Millington Regional Jetport and local topography considerations. Operations and Maintenance Negligible impacts to transportation.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction Construction traffic could result in decreases in the level of service from LSO-A to LOS-B for segments of the multiple roadways. All roadways would continue to operate an acceptable LOS-C or better in the converter station siting area. No railroads, airports, airstrips, or navigation aids would be affected. Operations and Maintenance Negligible impacts to transportation.
VEGETATION COMMUNITIES	
Common impacts to all converter station and AC interconnection siting areas	Construction may cause the direct impact of vegetation removal and the indirect impacts of reduction of plant vigor from mechanical damage, fragmentation, and the introduction of invasive species. Operations and maintenance of the Project would result in the continued absence of vegetation from the footprint of the facilities for the life of the Project. Operations and maintenance of the AC transmission lines for the interconnections would impact vegetation directly through mowing and pruning in the ROW and indirectly through herbicide applications that may impact non-target plant species.
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The dominant vegetation for the siting area is grassland and herbaceous cover (605 acres). Forty-five to 60 acres of land would be cleared and graded for the station facility footprint, plus an additional 5 to 10 acres of land for the overall construction. Vegetation would not be allowed to grow on these 45-60 acres for the life of the project and during construction of the project for the additional 5-10 acres. Clearing and grading activities for the access road would cause removal of approximately 4 acres of vegetation for the life of the Project. A maximum 200-foot-wide by 2.7-mile-long interconnection ROW would result in approximately 65.5 acres of long-term impacts, including the initial clearing of the existing vegetation. The structural footprint for the lattice structures would require less than 1 acre of long-term impact to vegetation. Operations and Maintenance Vegetation removed during the construction of the converter station or access road would not be replaced during the operations phase of the Project. Vegetation within the ROW of the AC interconnection would be maintained during the operations and maintenance phase of the Project. The projected acreage of vegetation to maintain in the AC interconnection ROW is 65.5 acres.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The dominant vegetation for the siting area for the Tennessee converter station includes cultivated crop lands (394 acres) and pasture/hay (195 acres). Forty-five to 60 acres of land would be cleared and graded for the station facility footprint, plus an additional 5 to 10 acres of land for the overall construction. Vegetation would not be allowed to grow on these 45-60 acres for the life of the project and during construction of the project for the additional 5-10 acres. Clearing and grading activities for the access road would cause the removal of approximately 4 acres of vegetation for the life of the Project. A maximum 200-foot-wide by 0.2-mile-long interconnection ROW would result in approximately 4.8 acres of long-

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
	term impacts to vegetation. The structural footprint for the lattice structures would require less than 1 acre of permanent impact to vegetation. Two tensioning sites would be needed, resulting in approximately 5 acres of potential temporary impact to vegetation.
	Operations and Maintenance Vegetation removed during the construction of the converter station or access road would not be replaced during the operations phase of the Project. Vegetation within the ROW of the AC interconnection would be maintained during the operations and maintenance phase of the Project. The projected acreage of vegetation to maintain in the AC interconnection ROW is 4.8 acres.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The dominant land cover type is evergreen forest (7,894 acres), followed by deciduous forest (5,425.4 acres), and pasture/hay lands (4,563.4 acres). There are also 363 acres of wetlands within the overall siting area. Forty-five to 50 acres of land would be cleared and graded for the station facility footprint, plus an additional 5 to 10 acres of land for the overall construction. Vegetation would not be allowed to grow on these 45-50 acres for the life of the project and during construction of the project for the additional 5-10 acres. Clearing and grading activities for the road would cause removal of approximately 4 acres of vegetation for the life of the Project. The following impacts would be expected: • Transmission line ROW: A maximum 200 foot-wide by 6-mile-long ROW would impact 121 acres of vegetation. • Lattice or monopole structures: Approximately 1 acre of vegetation removal. • Tubular pole structures: Less than 1 acre of vegetation removal. • AC Interconnection Siting Area: A 5-acre site would be required for the interconnection to an existing 500kV transmission line. An additional 5-acre area would be required during construction, resulting in a potential for 10 total acres of impact, split between 5 acres of long-term vegetation impacts and another 5 acres of temporary impact. Operations and Maintenance Vegetation removed during the construction of the converter station or access road would not be replaced during the operations phase of the Project. Vegetation within the ROW of the AC interconnection would be maintained during the operations and maintenance phase of the Project. The projected acreage of vegetation to maintain in the ROW is 121 acres.
VISUAL RESOURCES	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, and final converter station location. Vehicles, heavy equipment, structure components, ancillary facility components and materials, and workers would be visible during construction and would create short-term and local contrast within the areas of the ROW for the AC interconnection. Lighting of construction yards and work areas would create temporary visual impacts to night skies. Operations and Maintenance Facilities would contrast with the rural landscape and be visible on the horizon from large distances; however, the area is already impacted by numerous vertical structures such as wind turbines and existing transmission lines. There are no notable visual resources, so visual concern is low. Overall visual impacts would be low due to existing modification to the landscape and low number of sensitive viewers.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Same as described for the Oklahoma converter station. Operations and Maintenance Two key observation points were identified for the siting area. Depending on the observation point, the Project would result in moderate or strong contrast and moderate-high visual impacts.
Arkansas Converter Station Alternative and AC Interconnection	Construction Short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, and final converter station location. Vehicles, heavy equipment, structure components, and workers would be visible during converter station construction and modification, access and spur road clearing and grading, structure

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Siting Areas	erection, and cleanup and restoration. Affected viewers would be aware of the existing structures in the area adjacent to the Project and the temporary nature of Project construction impacts, which would decrease both scenic quality and viewer concern to the impact.
	Operations and Maintenance The surrounding landscape of the siting area is primarily rural and agricultural and other than rural residences, does not contain a high number of sensitive resources that would be impacted. When visible in the foreground, the facilities associated with the converter station would result in high contrast on the rural landscape, but given low numbers of sensitive viewers in the area, it would have an overall low-moderate impact.
WETLANDS, FLOODPLAINS, AND RIPARIAN AREAS	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction The Oklahoma Converter Station and AC Interconnection Siting Areas are dominated by grassland/herbaceous vegetation (605 acres). No wetland resources or 100-year floodplains were identified within the siting areas. Potential impacts to riparian areas are unlikely. Less than 2 miles of intermittent stream beds, no perennial streams, and no major waterbodies are present within the siting areas. Operations and Maintenance No impacts to wetlands, floodplains, or riparian areas are expected.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction The Tennessee Converter Station and AC Interconnection Siting Areas include approximately 6 acres of wetlands. The construction effort would avoid wetlands and waters of the United States to the extent practicable. Where impacts appear unavoidable, those wetland sites would receive a formal wetland delineation and appropriate consultation with the USACE. No 100-year floodplains occur with the siting area. Only 0.25 mile of perennial streams, 4.4 miles of intermittent streams, and no major waterbodies are present within the siting area. Potential impacts to riparian areas are unlikely. Operations and Maintenance If wetlands and riparian areas can be avoided during construction activity, then they should also be avoided during all operations and maintenance activities.
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Areas include approximately 96 acres of palustrine wetlands, 76 acres of lacustrine wetlands, and 191 acres of riverine wetlands (a total of 363 acres of wetlands). The converter station would ultimately only disturb approximately 60 acres of lands and it is very unlikely that these 60 acres would be focused on the wetland resources documented within the siting area. The construction effort should avoid wetlands and waters of the United States to the extent practicable. One floodplain could be impacted in the siting area. An estimated 73 acres of 100-year floodplain are contained with the siting area, and specific placement of the converter station infrastructure would determine the ultimate acreage impacted. The Arkansas Converter Station Alternative siting areas includes almost 13 miles of perennial streams and about 58 miles of intermittent streams. Riparian areas may be associated with many, if not all, of these surface water features. Considering the small size of the disturbance within the siting areas (approximately 60 acres vs. 20,000-acre siting area), these surface water features would likely be avoided, but where not, riparian areas could be affected. Operations and Maintenance Wetlands, floodplains and riparian areas associated with perennial streams have all been documented within the siting area, but ultimately only 60 acres of land would be disturbed. Therefore, these resources would likely be avoided during siting and would thus incur no impacts during operations and routine maintenance.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
WILDLIFE AND FISH	
Oklahoma Converter Station and AC Interconnection Siting Areas	Construction Wildlife species would be exposed to Project-related mortality or injury. Grasslands and croplands are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years). As a result, the majority of Project-related impacts to grasslands and croplands habitats would be short term in nature (i.e., those areas would restore to pre-construction conditions within 5 years or less) However, some permanent loss of grassland and croplands habitats would also occur as a result of the Project's permanent footprint. The grassland and cropland habitats found within the Oklahoma Converter Station and AC Interconnection Siting Areas are relatively common throughout the ROI; therefore, disturbance of 45–60 acres would not result in a significant impact to local wildlife. No perennial streams and no major waterbodies are located within the siting area. Coldwater Creek, a perennial stream, is within 1 mile of the siting area. Increased sedimentation is not likely to affect Coldwater Creek; however, if construction occurs near established intermittent waterways, there is potential for sediment to travel downstream and cause potential impacts to fish and aquatic invertebrate species.
	Operations and Maintenance Operation and maintenance activities would result in long-term impacts to the habitats. Some permanent loss of habitat would occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, transmission line structures, access roads, etc.).The permanent loss of habitat is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI. Operation and maintenance activities would not result in long-term impacts to fish and aquatic species because no major waterbodies or perennial streams are within the siting area, and downslope streams are approximately 1 mile away.
Tennessee Converter Station and AC Interconnection Siting Areas	Construction Croplands and pasture/hay lands are the dominant habitat types found in the siting areas. However, hardwood forests and riparian areas are also present. Croplands and pasture lands are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years). As a result, the majority of Project-related impacts to these areas would be short-term in nature. However, some permanent loss of habitats would still occur as a result of the Project's permanent footprint. Furthermore, because forests and riparian areas are also present, these types of habitats could also be potentially impacted as well. Forested and riparian areas could take decades to restore to pre-construction conditions if they are disturbed or cleared. There are no major waterbodies or streams located within the siting area. The Tennessee Converter Station Siting Area and AC Interconnection Siting Area borders Big Creek, a perennial stream, listed as impaired in 2010 for aquatic resources (fish, shellfish, and wildlife values). Impacts fish and aquatic species would likely be less if the facilities were located within the croplands and pasture/hay lands, and greater if they were located in forested areas due to the effects of long-term habitat loss from vegetation clearing, the extensive time necessary for forests to regenerate to pre-disturbance conditions and provide sediment retention, shade, and cover, and the impacts associated with edge effects in forested habitats that do not provide sedimentation retention, shade, and cover. Operations and Maintenance Operation and maintenance activities would result in long-term impacts to the habitats. Some permanent loss of habitat would occur as a result of the Project's permanent footprint (i.e., some areas would be encompassed permanently by Project structures such as the converter station, transmission line structures, access roads, etc.). The permanent loss of habitat is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI. However, species that are near or at carrying capacity may experience a reduction in population size due to this permanent loss of potential feeding and breeding A perennial stream flows adjacent and downslope along the western side of the siting areas. Additionally, a perennial stream flows through the middle of the siting area. Placement of roads and structures that could result in increased sedimentation from operations and maintenance activities could result in long-term direct and indirect impacts to fish and aquatic invertebrate species or their habitat.

Table 2.6-1:
Summary of Potential Environmental Impacts—Converter Stations and AC Interconnections

RESOURCE	IMPACT
Arkansas Converter Station Alternative and AC Interconnection Siting Areas	Construction The siting area contains a variety of habitats that range from forested areas to pasture lands. The Project could result in long-term impacts to wildlife habitats (due to the timeframes necessary for these forests areas to restore to pre-construction conditions). Because the pasture/hay fields that could potentially be impacted are capable of restoring to pre-disturbance levels in a short timeframe (defined as less than 5 years), most impacts to these types of habitats would be short-term in nature. However, some permanent loss of pasture/hay field habitats would still occur as a result of the Project's permanent footprint Impacts to wildlife would likely be less if the facilities were located within the pasture lands, and would be greater if they were located in forested areas due to the effects of long-term habitat loss, the extensive time necessary for forests to regenerate to pre-disturbance conditions, and the impacts associated with edge effects in forested habitats. Construction would not likely result in any direct impacts to fish and aquatic invertebrate species or their habitat because no waterbodies are located within the siting area. Indirect construction impacts should be minimal. However, if either siting area is upslope of any waterbodies, there is a potential for runoff to enter the waterway, causing potential indirect impacts to fish and aquatic invertebrate species. Operations and Maintenance The permanent loss of habitat is unlikely to have substantial long-term impacts to wildlife populations in the area because the type of habitats affected are common in the region and found elsewhere in the vicinity of the Project ROI. Direct impacts to fish and aquatic invertebrate species or their habitat are not expected because no waterbodies are located within the footprint of the interconnection area.

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Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
Agricultural Resources	Construction Cultivated crops would be directly affected by removal of vegetation and potential removal of agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Potential impacts to cultivated crops would vary based on the design and location of the proposed transmission line structures and access roads relative to existing agricultural operations. During construction, 325 to 1,365 acres of primarily grassland and cultivated crops would be disturbed depending on which AC collection system route is constructed. Construction of the AC collection system would directly affect livestock grazing by temporarily reducing forage and displacing livestock from grassland/herbaceous and pasture. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Construction and operations and maintenance of the proposed transmission lines could affect the economic value of livestock production in the representative ROW by increasing ranchers' costs and decreasing available forage. The Project could affect net earnings from livestock production in the following ways: • Decreased forage from land taken out of production • Increased management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment • Increased management costs associated with moving livestock around project-related structures and easements Operations and Maintenance Potential impacts to cultivated crops would vary based on the design and location of the AC collection system structures and access roads relative to existing agricultural operations. Long-term disturbance would result in 1.8 to 7.8 acres of primarily grassland/herbaceous and cultivated crops depending on which AC collection system route is constructed.

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
	Most agricultural activities such as livestock grazing and cultivating crops could be returned to the ROW upon the completion of construction.
Air Quality and Climate Change	Construction Construction activities would result in air quality and greenhouse gas emissions. Emissions are not anticipated to cause or significantly contribute to a violation of an applicable ambient air quality standard or contribute substantially to an existing or projected air quality violation. Operations and Maintenance There would be negligible amounts of air pollutants from maintenance activities. Operations and maintenance of the AC collection system would not emit pollutants; however, maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment.
Electrical Environment	Construction No electrical effects would be associated with construction of the AC collection system because these facilities would not be energized during construction. Operations and Maintenance Calculations with respect to electrical fields, magnetic fields, audible noise, radio noise, television noise, and ozone were performed for each of the configurations and the results are as follows: • Calculated AC electric field levels at the ROW edges would be below guidelines for public exposure (established by non-regulatory organizations such as the Institute of Electrical and Electronics Engineers [IEEE], American Conference of Governmental Industrial Hygienists [ACGIH], and the International Committee on Non-Ionizing Radiation Protection [ICNIRP]). Within the ROW, calculated electric field levels would be below some guidelines for transmission line ROWs, but exceed some public exposure guidelines. For the single circuit lattice structure configuration, calculated electric field levels exceed guidelines for workers with implanted medical devices at the ROW edges if the ROW width is only 150 feet, but comply if the width is 200 feet. • Calculated magnetic field levels at the ROW edges are below guidelines for public exposure (established by non-regulatory organizations such as the IEEE, ACGIH, and ICNIRP) and within the ROW are below guideline for workers with implanted medical devices. • Calculated audible noise levels at the ROW edges are below the EPA guideline for noise. • Calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE threshold during fair weather conditions but are slightly above that threshold during rainy weather. • Television noise could cause interference. No interference from corona-generated noise expected for digital signals broadcast at frequencies above 1 gigahertz from satellites. • Maximum ozone levels are far below the EPA standard. • Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the AC collection system would pose a known threat to human health. • Overall, the likelihood of annoyance to landowners by audible noise from the line or interference with AM radio or television reception is small.
Environmental Justice	Construction/Operations and Maintenance No long-terms impacts to low-income or minority populations are anticipated.
Geology, Paleontology, Soils, and Minerals	Construction Designated Farmland. AC Collection System Route SW-1 would impact the least amount (9 acres) of designated farmland. AC Collection System Routes E-2, NW-1, NW-2, SE-1, and SE-3 would impact the greatest amount (502 to 671 acres) of designated farmland. Soil Limitations. Depending on the AC collection system routes that are implemented, construction would result in: • Disturbance of 128 to 1,125 acres of karst and 43 to 138 acres of shallow bedrock • 127 to 1,209 acres of soils with high compaction potential • 76 to 779 acres of soils with moderate to high wind erosion potential • 0 to 46 acres of soils with slopes of 15% to 30%

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
	• Temporary disturbance to soils from access roads Soil Contamination. One facility/site with known contamination was identified within the AC Collection System Route SW-2. That location would likely be avoided. Operations and Maintenance Impacts to soils generally depend on the length and area covered by the routes, which generally correlates with the amount of access roads and ROW. Other impacts depend on farmland and soil limitation parameters that might be affected. Impacts to soils would be limited to the actual transmission line structure footprints and from occasional use of the ROW for maintenance access. Impacts from access roads might expose soils to erosion and compaction. Impacts caused by new structures would be permanent during operations and maintenance and the access impacts would be temporary and minimal.
Groundwater	Construction Common impacts among the AC collection system routes include (1) potential for contamination from spills or leaks of fuels and lubricants, (2) short-term changes in infiltration rates in areas of land disturbance, (3) minor impacts to water availability from water demands (low demand as compared to availability), and (4) potential damage to wells and associated piping systems in construction areas. The deepest foundations for transmission line structures would be in the range of 30 to 44 feet below ground. Based on the typical depths to groundwater in the five counties in which the AC collection system routes would be located, it is expected that construction of foundations for transmission line structures would not reach groundwater. Five of the representative ROWs associated with AC Collection System Routes E-1, E-2, E-3, SE-1, and SE-3 would encompass 14 to 174 acres of nutrient-vulnerable groundwater, but do not cross areas with special source groundwater. The total number of wells (private domestic, public water supply, agricultural, and industrial) within the ROWs range from 0 to 8. Operations and Maintenance No impacts to groundwater.
Health, Safety, and Intentional Destructive Acts	Construction/Operations and Maintenance The Project would introduce hazards that could affect worker and public health and safety. Natural events, external events or accidents (e.g., aircraft mishaps or fires) or intentional destructive acts or mischief could impact such infrastructure and have related effects on the health and safety of construction workers and the public. The Project would involve the transportation and handling of hazardous materials. The implementation of EPMs associated with management of hazardous materials would keep risks to a minimum.
Historic and Cultural Resources	Construction AC Collection System Routes NE-1, NE-2, SE-1, SE-2, and SW-1 contain no previously recorded archaeological sites or other historic properties. AC Collection System Routes E-1, E-2, E-3, and SE-3 each contain one previously recorded archaeological site that has not been evaluated for NRHP eligibility. None contain previously recorded historic buildings. AC Collection System Routes NW-1 and NW-2 each contain two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. AC Collection System Route NW-1 contains no previously recorded historic buildings. The NRHP-listed Tracey Woodframe Grain Elevator is located in the vicinity of AC Collection System Route NW-2. AC Collection System Route SW-2 contains three previously recorded archaeological sites, none of which have been evaluated for NRHP eligibility. The route contains no previously recorded historic properties. AC Collection System Route W-1 contains two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. The route contains no previously recorded historic properties. A cultural resources survey within AC collection system would be performed prior to construction of the Project to assess the possible impacts of construction on such resources if present. Operations and Maintenance No impacts would be expected.

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
Land Use	Construction The majority of the impacts to land use would be temporary. Construction would temporarily prevent the use of rangeland and cultivated crops in the ROW. Depending on the AC collection system route, disturbance of primarily grassland and cultivated crops would range from 325 to 1,365 acres. There are 0 to 2 structures present in ROWs. Operations and Maintenance It is anticipated that all existing roads and existing roads with repairs/improvements would be retained for operations and maintenance of the Project. It is estimated that approximately 75% of the new overland roads with no improvements and 90% of the new overland roads with clearing and new bladed roads would be retained for operations and maintenance access. These roads would be up to 20 feet wide. Access roads that are not needed for operations and maintenance would be restored. All other land in the ROW could return to most previous land uses if they are compatible with operations and maintenance of the Project. Some uses may be impeded in the ROW, such as using farming equipment near the pole structures or crop-dusting planes that would not be able to approach the transmission lines. Land uses that would not be permitted in the ROW include buildings or structures, changing the grading and land contours, and some restrictions and coordination for infrastructure such as fences and irrigation lines. In addition, access would be restricted during the performance of maintenance activities. All of the tensioning and pulling areas could return to existing uses once construction has been completed.
Noise	Construction Depending on the route, noise sensitive areas may experience short-term and temporary elevated noise levels. Operations and Maintenance Operations and maintenance would include the use of trucks, lifts, or other equipment as needed on a periodic basis along the AC collection system. Depending on the route, some noise sensitive areas could experience adverse noise impacts under certain operational and weather conditions.
Recreation	Construction Construction is not expected to permanently preclude the use of or access to any existing recreation areas or activities since no recreation resources have been identified within the representative ROW for any routes. The southern boundaries of the Optima National Wildlife Refuge (NWR) and the Optima WMA are located to the north of AC Collection System Route E-1. At the closest point, the Optima NWR and the Optima WMA are approximately 1,500 feet from this route, and about 1.5 miles from the Optima lake shoreline, which is within the NWR and WMA areas. The boundaries of the Schultz Lake State Park and Schultz WMA are located to the north of AC Collection System Route SE-1. At the closest point, the Schultz Lake State Park and Schultz WMA are approximately 0.5 mile from the route. Long-term indirect impacts would result from vegetation clearing and structure erection and could have impacts on recreational visitors due to changes in for the scenic landscapes provided by the Optima NWR and Optima WMR and Schultz Lake State Park and Schultz WMA. Operations and Maintenance No impacts to recreation resources are anticipated from operations and maintenance of any of the AC collection system routes because no recreation resources are located within the representative ROW.
Socioeconomics	Construction Population and community service impacts would be short term and temporary. Economic condition impacts would be positive, short term, and temporary. Impacts have the potential to be more substantial in Region 1, where existing housing resources are more limited, if construction is concurrent with construction of the HVDC line and Oklahoma converter station; this potential shortage would be further exacerbated if Project construction coincides with construction of wind projects. Tax revenue impacts would be short term and temporary from sales, use, and lodging taxes, ranging from $0.2 million to $2.5 million per route alternative. Operations and Maintenance Operations and maintenance are unlikely to affect regional agricultural production and employment, but could have localized impacts. Some short-term adverse impacts on residential property values (and saleability) might occur on

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
	an individual basis as a result of the Project. However, these impacts would be highly variable, individualized, and are difficult to predict. Positive tax revenue impacts (less than $1 million per route) would be expected from annual ad valorem or property taxes.
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	Construction Habitat loss and fragmentation of existing grassland habitat is one of the primary threats to the lesser prairie-chicken (LEPC). The highest quality LEPC habitat (based on Crucial Habitat Assessment Tool [CHAT]-1 and CHAT-2) occurs on the eastern side of the AC collection system area. To the extent that the AC transmission lines and access roads cross contiguous areas of native grasslands, construction of the AC collection system may contribute to the loss of potential LEPC habitat. These impacts could be minimized with routes that follow existing ROWs, areas of cultivated fields, and grassland areas already fragmented by other activities that are areas of low quality prairie chicken habitat. The Sprague's pipit also uses native grasslands and could be similarly affected by loss of habitat and fragmentation. Special status fish, aquatic invertebrate, and amphibian species potentially occurring within the AC collection system routes include populations of the Arkansas River shiner. The Beaver River and Palo Duro Creek, which are crossed by several routes, may provide aquatic habitat for the Arkansas River shiner. Potential direct impacts include grading, access roads, herbicide use, and handling of fuel and lubricants where the Beaver River and Palo Duro Creek would be crossed by the routes. Operations and Maintenance Potential impacts to special status wildlife species include mortalities from collisions with transmission lines and structures and possible electrocutions, disturbance impacts from routine maintenance activity, and loss of habitat by behavioral avoidance of areas surrounding vertical structures (i.e., transmission structures and lines). There is a potential risk of mortalities to whooping cranes and golden eagles from collisions with transmission lines and structures. The prairie chicken is a low flier and typically avoids areas surrounding tall structures. Routine maintenance and inspection work is unlikely to impact special status wildlife species other than a temporary displacement while work is performed. However, any avoidance of areas by the LEPC due to the potential for increased predation rates (due to consolidation of raptors and corvids along the AC collection lines) would constitute a loss of habitat. The use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts to the Arkansas River shiner or its potential habitat in the Beaver River and Palo Duro Creek. The potential application of herbicides could result in indirect impacts, and to a lesser extent, direct impacts.
Surface Water	Construction Common impacts include (1) potential for runoff and receiving water contamination from spills or leaks of fuels and lubricants, (2) short-term changes in runoff rates in areas of land disturbance, (3) possible disturbance of drainage features, including intermittent or perennial streams, from construction of access roads; and (4) impacts to water availability from water demands. Depending on the route, potential impacts could occur to the following surface water resources: (1) the 200-foot ROWs contain 0 to 0.51 mile of perennial streams, 0.25 to 2.15 miles of intermittent streams, 0 to 0.18 mile of major waterbodies, and 0 to 2.61 acres of reservoirs, lakes or ponds; (2) AC Collection System Route SE-3 crosses Wolf Creek, designated a Texas ecologically unique stream segment; (3) six of the routes cross impaired water segments of Beaver River or Palo Duro Creek; and (4) the depth to water table is great enough that pumping and discharge of groundwater during construction is unnecessary. Operations and Maintenance Operations and maintenance would not impact surface water.
Transportation	Construction Only minor decreases in the level of service for area public roadways in the ROI would be expected. These decreases would be temporary. Operations and Maintenance None of the routes would result in impacts to traffic, railroads, or airports/airfields.

Table 2.6-2:
Summary of Potential Environmental Impacts—AC Collection System

RESOURCE	IMPACT
Vegetation Communities	Construction Impacts include the initial clearing of vegetation in the ROW and the removal of vegetation in the locations of lattice structure placements. The range of potential impacts from vegetation clearing in the ROW ranges from 325 acres to 1,365 acres. There would be 1.9 acres to 7.8 acres of permanent vegetation loss at structural foundation placements. Operations and Maintenance There would be some degree of regular mowing and trimming of vegetation in any of the routes. None of the routes have forested land cover, so there would be little to no change in the structural form of the vegetation. Depending on the route, the projected acreage of vegetation to maintain in the ROW is between 325 and 1,365 acres.
Visual Resources	Construction There would be short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, along access roads, and along the new transmission line ROW. Vehicles, heavy equipment, structure components, and workers would be visible during transmission line construction and modification, access and spur road clearing and grading, structure erection, conductor stringing, and cleanup and restoration. However, disturbance from construction activities would be transient and of short duration as activities progress along the transmission line route. Affected viewers would be aware of the temporary nature of Project construction impacts, which may decrease their concern to the impact. The structures and cables (transmission lines) would cause the major long-term change in scenery. Operations and Maintenance The routes are located in a sparsely populated area in a landscape that is primarily flat agricultural lands offering open panoramic views. The region does not contain a high number of sensitive viewers or sensitive resources, so impacts would be expected to be low-moderate. The routes are located in a largely open and undeveloped landscape, and the introduction of large vertical elements such as a transmission line, would have the potential to affect viewers over a large viewing area. Thirteen viewing locations were identified for the routes.
Wetlands, Floodplains, and Riparian Areas	Construction Impacts may vary from short term to long term, and potentially there may be permanent loss of wetland acreage. Potential impacts to wetlands for the various routes range from 0 acre to 20.1 acres. Potential impacts to floodplains range from 0 to 54.6 acres. Riparian areas could be associated with surface water features, which range from 0 to 0.5 mile of perennial streams, 0.3 to 2.9 miles of intermittent streams, 0 to 0.2 mile of major waterbodies, and 0 to 2.6 acres of reservoirs, lakes, and ponds Operations and Maintenance Impacts may result from use of heavy machinery through wetlands, floodplains, and riparian areas. These impacts can cause soil compaction and mechanical damage or removal of vegetation. These impacts are anticipated to cover a range from temporary to potentially more severe and long-term/permanent. The use of vegetation management would be necessary to protect the Project infrastructure and enhance safety. However, the trimming, mowing, or removal of vegetation can cause changes to plant diversity and function in all three ecosystem types (i.e., wetlands, floodplains, and riparian areas). Vegetation maintenance in wetlands and riparian areas should be kept to a minimum. Additionally, the use of herbicides can cause few to severe impacts to vegetation in areas where they are applied.
Wildlife and Fish	Construction/Operations and Maintenance Some routes would have an elevated risk of avian collision during the migration seasons compared to the other routes, as well as a higher potential for disturbances to important wildlife areas due to these routes proximity to important wildlife areas (i.e., Optima NWR and Optima WMA). There would be no substantial difference between the other routes considered with regard to the types of wildlife impacts that would likely occur as a result of the route location and position; however, longer routes would likely have a greater impact due to the greater length and extent of areas impacted. The length of the various AC collection system routes range from 13 to 56 miles. There is potential for mortality, injury, and disturbance to fish and aquatic invertebrates, and aquatic habitat loss and modification where waterbodies (e.g., perennial, intermittent) would be crossed by routes.

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
Agricultural Resources	Construction Construction could affect livestock grazing by temporarily reducing forage and displacing livestock in the ROW. Croplands would be directly affected by removal of vegetation and agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. Potential temporary impacts to center-pivot irrigation could occur primarily in Regions 1, 2, 6, and 7. The operation of center-pivot irrigation could be limited in construction areas. During construction, access roads, temporary work areas, and other graded areas could temporarily disrupt the slope and flow patterns of water on flood-irrigated fields. Operations and Maintenance Maintenance may occasionally disrupt agricultural activities and production on a localized basis. Potential indirect impacts to agricultural production from interference with aerial applications of fertilizer, insecticide, and herbicide, could occur. Most of the land within the ROWs could return to previous uses after construction. Land uses that would not be permitted in the ROW include buildings or structures, changes to grading and land contours, and some restrictions for infrastructure such as fences and irrigation lines. Maintenance activities may cause temporary impacts within the ROW such as damage to crops.
Air Quality and Climate Change	Construction Construction-related emissions would be below thresholds for all criteria pollutants across all alternatives. Temporary construction impacts to air quality include emissions near sensitive areas such as residences or schools for short periods of time. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Air quality emissions would be elevated during construction, however typically Project construction would move relatively rapidly along a given ROW, with temporary impacts lasting for only a few days or weeks in a given area. Operations and Maintenance Operations and maintenance would emit negligible air pollutants associated with combustion of fossil fuels for worker vehicles and equipment.
Electrical Environment	Construction No electrical effects would be associated with construction because the transmission line would not be energized yet. Operations and Maintenance Calculated DC electric fields are below public guidelines (such as IEEE, ACGIH, and ICNIRP) at the ROW edges if the ROW width is 200 feet. Calculated DC electric fields also conform to occupational standards within the ROW, except for the dedicated neutral return configurations. Calculated DC magnetic fields are below public guidelines (IEEE, U.S. Food and Drug Administration, ACGIH, and ICNIRP) at the ROW edges for all configurations. Calculated audible noise is below the public guideline at the ROW edges if the ROW width is 200 feet. Calculated radio noise is below Federal Communications Commission and IEEE exposure guidelines. It is unlikely that the proposed HVDC transmission line would pose a known threat to human health.
Environmental Justice	Construction/Operations and Maintenance There would be no impacts to areas where no minority or low-income populations were identified. For areas where minority and/or low-income populations were identified, it is expected that any impacts would affect all populations equally.
Geology, Paleontology, Soils, and Minerals	Construction/Operations and Maintenance Long-term impacts from the Project include the conversion of geology, mineral resources access, and soils resources (especially farmland) to a utility use, primarily for access roads, and transmission line pole structure locations. Impacts include potential damage to Project infrastructure and equipment from seismicity, landslides, subsidence, or soil liquefaction. Blasting may be necessary in areas of shallow bedrock. Impacts to soil resources from construction activities are associated with clearing, grading, excavation, and other activities necessary for construction that could expose erosion-prone soils to conditions of increased erosion potential; and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Impacts to soils would also include the potential for loss of soil productivity. Inadvertent spills of fluids used during construction, such as fuel, lubricants, antifreeze, and herbicides could directly impact soils through contamination; and excavation activities during construction might uncover previously unknown areas of contaminated soils. Seismic hazards are low for the entire Project except for the eastern portion of the ROI in Region 5 and all of Regions

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	6 and 7 in the area of the New Madrid Seismic Zone. Areas of high to very high soil liquefaction potential are present in the Project Regions 4, 5, 6, and 7. Subsidence from karst is a possible geologic hazard of concern within Regions 1, 2, 4, and 5. Areas of high susceptibility for landslides are present in Project Regions 4, 5, and 7.
Groundwater	Construction Typical construction impacts include: • Potential for Groundwater Contamination—Contamination could occur as a result of the accidental release of hazardous substances, primarily fuels and lubricants, which would be used for construction equipment and be present in construction staging or storage yards. Compliance with permit requirements and implementation of EPMs, including spill prevention and response planning, would minimize the potential for groundwater contamination. • Changes to Infiltration Rates—Soils disturbed and loosened during construction could represent areas of increased precipitation infiltration, possibly increasing local groundwater recharge rates over the short term. After construction, impermeable facility surfaces would represent areas of decreased infiltration rates over the long term. The area of impermeable surfaces resulting from the Project would be small. In accordance with the Applicant's EPMs, soils would be returned to pre-activity conditions, therefore resulting in *de minimis* long-term impacts to infiltration rates. • Effects on Water Availability—Water demands to support the Project could come from groundwater resources (more likely in areas where total water use is typically from groundwater sources such as Regions 1, 2, and 6) and result in less groundwater being available for other uses. Water demand associated with the Project is not expected to have noticeable effects on groundwater resources beyond those resulting from existing water usage. • Physical Damage to Well Systems—Well system damage could occur as a result of direct impacts from equipment traffic or during excavations, and could also occur at locations more remote from construction if blasting was used at excavation sites. The Applicant's EPMs would minimize these occurrences and require repairs of any damages and, in the case of any damage, arrange for temporary water supply, if necessary. Pre-construction planning, working with property owners to identify well system locations, and adjusting construction sites to avoid well systems are among the actions that would be taken to minimize the potential for damaging well systems. Operations and Maintenance Potential impacts to groundwater would be very minor. The quantities of hazardous materials present (primarily fuels and lubricants in maintenance vehicles and equipment) would be much less than during construction and water demands of facilities would be limited to that required to support the small number of employees.
Health, Safety, and Intentional Destructive Acts	Construction/Operations and Maintenance Construction and operational activities for large infrastructure projects, such as a transmission line and associated facilities can pose hazards that affect worker and public health and safety. In addition, natural events, external events or accidents (e.g., aircraft mishaps or fires) or intentional destructive acts or mischief could impact such infrastructure and have related effects on the health and safety of construction workers and the public. The Project may involve the transportation and handling of hazardous materials. Management (i.e., transportation, storage, handling, use, and disposal) of such hazardous materials during the construction and operations and maintenance phases would be undertaken in a manner to avoid or minimize health and safety impacts to workers and nearby members of the public. The implementation of EPMs associated with management of hazardous materials would keep risks to a minimum. The transmission lines and associated facilities could be susceptible to natural events such as extreme weather. Based on accident statistics for the construction and operational utility industries, the estimated construction workforce Project would experience 125 non-fatal recordable incidents during the 42-month construction period. Using the average construction workforce of 965 workers, it is estimated that there would be approximately 0.3 fatalities during the 42-month construction phase. It is likely that no fatalities would occur. During the assumed 80-year operational period of the Project, the average operations workforce would experience 2.0 non-fatal recordable incidents annually. The construction and operational impacts of the HVDC alternative routes would be roughly equivalent to those of the Applicant Proposed Project.

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
Historic and Cultural Resources	Construction Potential impacts would be experienced primarily during construction. Potential construction impacts to belowground (archaeological) resources could occur as a result of ground disturbances at site locations. Potential project impacts to aboveground historic and cultural resources such as buildings and structures would most likely be limited to visual alterations in the historical setting of the resource. Such alterations would be introduced through the erection of transmission structures, and stringing of conductors. Potential Project impacts to aboveground historic and cultural resources would be long-term for the life of the Project. Construction could also cause temporary impacts to historic and cultural resources through the generation of dust, noise, and vibration, but such effects would be transient in nature. Operations and Maintenance Additional ground disturbance impacts to archeological resources are unlikely to occur during operations and maintenance. Once built, the Project facilities are not likely to be substantially altered through routine operations and maintenance.
Land Use	Construction Land use impacts consist primarily of the conversion of existing land uses (primarily rangeland, cropland, and pasture/hay) to a utility use. Typical temporary impacts include the use of some areas for temporary work areas and loss of access to areas in or adjacent to work areas. Construction would prevent the use of rangeland and cultivated crops in the ROW in a specific location and may change the contour of the land and affect irrigation infrastructure. Yields from cropland, pasture/hay, and timberlands could potentially also be temporarily affected in the construction areas. There are 28 structures within the representative ROW for the Application Proposed Route, including 18 agricultural structures, 2 industrial structures (oil/gas infrastructure), 2 commercial structures, 2 residential structures, 2 abandoned structures, and 2 other structures (use unknown). Alternative routes with fewer structures than the corresponding links of the Applicant Proposed Route include HVDC Alternative Routes 2-B (one fewer agricultural structure), 6-C (three fewer agricultural structures), 7-A (one fewer structure [use unknown]), and 7-D (two fewer agricultural structures). All other alternative routes contain more structures within the representative ROW than the corresponding links of the Applicant Proposed Route. These structures would have to be permanently removed if the Project features could not avoid them. The USFS has expressed several concerns regarding HVDC Alternative 4-B. According to the USFS, the ROW would create linear breaks in National Forest land and could adversely affect timber production. The USFS has also stated that, in places, HVDC Route Alternative 4-B would undermine the use for which the National Forest land was originally acquired, that is conservation of natural resources. Operations and Maintenance Long-term impacts from the Project include the conversion of land to a utility use, primarily for access roads and transmission line structure locations. Most of the land within the transmission ROWs could return to previous uses after construction, although uses incompatible with the operation of the transmission line, such as tall trees for timber, would be removed permanently from the ROW. Land uses that would not be permitted in the ROW include buildings or structures, changes to grading and land contours, and some restrictions for infrastructure such as fences and irrigation lines. Maintenance activities may cause temporary impacts within the ROW such as damage to crops.
Noise	Construction Temporary impacts include elevated sound levels at noise sensitive areas such as residences or schools for short periods of time. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Sound levels would be elevated during construction of the HVDC transmission lines. Operations and Maintenance Sound from operation of the HVDC transmission lines results from corona effects, which can result in audible noise. Corona noise is greatest on HVDC transmission lines when the lines are dry. There are two noise sensitive areas expected to exceed federal guidelines near the Applicant Proposed Route in Region 3.
Recreation	Construction Construction of the Project is not expected to permanently preclude the use of or access to any existing recreation areas or activities. Temporary impacts include the use of some recreational areas for temporary work areas and loss of access to recreation areas in or adjacent to work areas. Direct short-term impacts may include noise, visual

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	disturbance, restricted access, and diminished quality of recreational impacts that are crossed by the representative ROW. The main differences in potential recreation impacts between the Applicant Proposed Route and the HVDC alternative routes occur in Regions 3, 4, and 5. The Applicant Proposed Route Link 1 in Region 3 would not cross Lake Carl Blackwell, while corresponding Alternative Routes 3-A and 3-B could impact approximately 23 acres of the lake. The Applicant Proposed Route Link 6 could potentially impact 4 acres of the Webbers Falls Lock and Dam Reservoir lands while the corresponding HVDC alternative routes in Region 3 could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir lands. The Applicant Proposed Route in Region 4 could potentially impact 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA, while the corresponding HVDC alternative routes in Region 4 would not. Applicant Proposed Route Link 1 in Region 4 could potentially impact 17 acres of the Webbers Falls Lock and Dam Reservoir lands. There is no HVDC alternative route to this link of the Applicant Proposed Route. The Lee Creek Variation (Applicant Proposed Route in Region 4, Link 3) would cross the Nationwide Rivers Inventory segment of Lee Creek, while the Alternative Routes 4-A and 4-B would also cross the Nationwide Rivers Inventory segment of Lee Creek. HVDC Alternative Route 4-B could impact approximately 230 acres of the Ozark National Forest, while the Applicant Proposed Routes in Region 4 would only potentially impact approximately 2 acres. The Applicant Proposed Route in Region 5 could potentially impact 77 acres of the Cherokee WMA while the alternative routes in Region 5 would not. The representative ROW for HVDC Alternative Routes 6-C and 6-D does not include any natural areas or recreational land compared to the corresponding link of the Applicant Proposed Route, which includes approximately 0.5 acre of the Singer Forest Natural Area within the St. Francis Sunken Lands WMA. Operations and Maintenance Most of the land within the HVDC transmission line ROWs could return to previous uses after construction. Recreation uses would be permitted in the ROW; however; buildings or structures, and some restrictions for infrastructure such as fences would not be permitted. Maintenance activities may cause temporary impacts within the ROW such as restricted access.
Socioeconomics	Construction Construction of the Project would generate regional economic activity through Project-related expenditures on materials and supplies. The Project would also employ construction workers who would spend much of their income locally and support jobs and incomes elsewhere in the economy. Approximately 26% of the construction workforce is expected to be hired locally (i.e., workers who normally reside within daily commuting distance of their job site), with the remaining 74% temporarily relocating to communities along the ROI for the duration of their employment. There is a potential shortage of temporary housing and RV spaces in Region 1 that would be further exacerbated if the construction schedules for the Oklahoma converter station, AC collection system, and HVDC transmission line were to overlap. This availability could be further reduced by other outside activities in the ROI such as other construction projects, community-sponsored events, and hunting and other recreational activities, as well as connected actions, specifically the development of wind generation facilities and the Optima Substation. The Applicant proposes to prepare and implement a workforce housing strategy designed to minimize potential impacts to housing availability. Some short-term adverse impacts on residential property values (and marketability) might occur on an individual basis as a result of the Project. However, these impacts would be highly variable, individualized, and are difficult to predict. Minor, short-term increases in demand from construction workers and family members temporarily relocating to local communities within the ROI are not expected to affect the levels of service provided by existing law and fire personnel, health care and medical facilities, or educational facilities. Minor increases in population resulting from operations and maintenance of the Project are also not expected to affect the provision of community services. Construction of the Applicant Proposed Route would generate sales, use, and lodging tax revenues during the construction period, with an estimated 90% of total construction costs expected to be for materials subject to sales and use tax. Total estimated state sales and use tax revenues range from $2.1 million in Tennessee to $34.6 million in Oklahoma; the estimated total for Arkansas would be $32.3 million. Local spending by construction workers would also generate sales and lodging tax revenues. Substituting one or more of the HVDC alternative routes for the corresponding links of the Applicant Proposed Route would not substantially affect the regional economic impact estimates. The largest net increases in the number of people who would temporarily relocate to each region, relative to the Applicant Proposed Route would occur in Region 1 with the addition of 16 people (HVDC Alternative Route 1-A) and

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	in Region 7 where 14 and 19 more people could be added (HVDC Alternative Routes 7-C and 7-A, respectively). The majority of the HVDC alternative routes would not affect the peak number of school age children temporarily relocating to the affected regions. In other cases, there would be a potential increase of one to two school-age children relative to the Applicant Proposed Route for that region. Relative to the Applicant Proposed Route, the largest changes in estimated sales and use tax revenue that would accrue to the respective state would occur in counties in Region 5 and range from a decrease of $2.75 million (-100%) in Cleburne County, Arkansas, to an increase of $2.55 million (100%) in Faulkner County, Arkansas. Changes in estimated sales and use tax that would be paid to each county would range from a decrease of about $0.7 million in Cleburne County, Arkansas (Region 5), to an estimated increase of $0.5 million in Shelby County, Tennessee (Region 7). Operations and Maintenance Operations would have similar, but smaller regional economic benefits than construction. Operation of Project facilities would generate ad valorem or property tax revenues in the counties where they would be located. Operation-related expenditures would generate sales and use tax revenues. Estimates of annual county tax revenues in Oklahoma range from $0.1M to $2.4M. Estimates of annual county tax revenues in Arkansas range from $0.2M to $0.6M. Estimates of annual county tax revenues in Tennessee range from $0.2M to $0.3M. Substituting one of more of the HVDC alternative routes for the corresponding link of the Applicant Proposed Route would not affect estimated operations and maintenance employment for the HVDC and AC transmission lines. Potential impacts to population, economic conditions, housing, and community services from operations and maintenance related to estimated operations and maintenance employment would be the same or very similar to those described above for the Applicant Proposed Route.
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	Construction/Operations and Maintenance Impacts to special status wildlife species in Region 1 from the Applicant Proposed Route or alternative routes include potential habitat loss and fragmentation of existing habitat of LEPC habitat mapped focal areas (CHAT-1) or connectivity zone habitat (CHAT-2) HVDC Alternative Route 2-A in Region 2 is parallel to the Cimarron River for a portion of the route. This portion of the Cimarron River is known to be used by the interior least tern. Therefore construction of this alternative route could disturb habitat or individuals. HVDC Alternative Route 3-C in Region 3 has slightly more forested land than other alternative routes or the Applicant Proposed Route and therefore could potentially impact the American burying beetle. HVDC Alternative Route 4-B in Region 4 includes forested lands and is closer to the Ozark Plateau region than other alternative routes and the Applicant Proposed Route. The Ozark Plateau region contains cave hibernacula for special status bat species. Because of the amount of forested areas, there is a potential for greater mortality impacts to the American burying beetle during construction. The increase in forested land in closer proximity to areas of caves known to be or potentially used by bats increases the potential impacts (e.g., disturbances to or loss of roost trees) to the special status bat species along this route Similarly, HVDC Alternative Route 4-D also contains more forested land than other alternative routes and the Applicant Proposed Rout in Region 4. Therefore, there could be construction impacts to the American burying beetle and the special status bat species along this route. Direct construction impacts that could potentially affect special status fish, aquatic invertebrate, and amphibian species and their habitats include vegetation clearing, grading, access roads, herbicide use, and handling of fuel and lubricants at stream and river crossings. Vegetation clearing has the potential to increase sedimentation and decrease cover. Increased sedimentation can directly or indirectly suffocate, bury, or limit feeding of fish, aquatic invertebrate, and amphibian species. Grading and access roads have the potential to increase sedimentation, decrease cover, and increase runoff. Increased runoff can alter stream and river hydrology and provide a mechanism for delivery of sediment, herbicides, and fuel and lubricants to streams and rivers. Herbicide use and handling of fuel and lubricants have the potential to concentrate in body tissues of fish, amphibians, and filter-feeding mussels, which can result in death. During the construction phase of the Project, all general EPMs and those specific to special status fish, aquatic invertebrates, and amphibians would be implemented to avoid or minimize impacts to special status fish aquatic invertebrates, and amphibians. For all regions except Region 2, there would be no difference in impacts between the Applicant Proposed Route and the HVDC alternative routes. For Region 2, HVDC Alternative Route 2- has more acres of waters designated by the USFWS as critical habitat for the Arkansas River shiner within the ROI than the corresponding link of the Applicant

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
	Proposed Route. Both the HVDC Alternative Route 2-A and the corresponding of the Applicant Proposed Route cross the Cimarron River at separate locations where it is USFWS designated critical habitat, but HVDC Alternative Route 2-A is within the critical habitat for more acres. Potential impacts in the operations and maintenance phase of the HVDC transmission line would be similar to the potential impacts in the construction phase; however, impacts would be at a lesser extent than in the construction phase, but occur throughout the life of the Project. During the operations and maintenance phase, the use of both access roads and the ROW for repair and maintenance activities could result in both direct and indirect impacts to the Arkansas River shiner or its potential habitat in the Beaver River and Palo Duro Creek. In addition, the potential application of herbicides during operations and maintenance of the Project could result in indirect impacts, and to a lesser extent, direct impacts. During the operations and maintenance phase of the Project, both general EPMs and those specific to fish aquatic invertebrates, and amphibians would be implemented to avoid or minimize impacts to special status fish, aquatic invertebrates, and amphibians.
Surface Water	Construction Typical impacts include: • Potential for Surface Water Contamination—Contamination could occur as a result of the accidental release of hazardous substances, primarily fuels and lubricants, which would be used by construction equipment and be present in construction staging or storage yards. Permit compliance and implementation of EPMs, including spill prevention and response planning, would minimize the potential for surface water contamination. • Changes to Runoff Rates—Soils disturbed and loosened during construction could represent areas of increased precipitation infiltration, possibly decreasing local runoff rates over the short term. Surfaces compacted during construction and impermeable facility surfaces remaining after construction would represent areas of increased runoff rates. The area of impermeable surfaces resulting from the Project would be small. In accordance with the Applicant's EPMs, soils would be returned to pre-activity conditions, therefore resulting in *de minimis* long-term impacts to runoff rates. • Direct Impacts or Disturbances to Surface Water or Drainage Channels—Surface waters and drainage channels would be avoided as practicable in the placement of transmission line facilities, with transmission lines spanning such features as necessary. Access roads may not always have the same means of avoidance and would be most likely to involve disturbance of drainage features. Preplanning of the crossing methods would minimize the length of the drainage feature affected and enhance the ability to maintain flow characteristics. • Effects on Water Availability—Water demands to support the Project could come from surface water resources (more likely in areas where total water use is typically from surface water sources such as Regions 3, 4, and 5) and result in less surface water being available for other uses. The Project's water demand is not expected to have noticeable effects on surface water resources beyond those resulting from existing water usage. There are differences in the amount of surface water used between regions and in the numbers of surface water features within the representative ROWs for each of the HVDC alternative routes. Water demands from the Project are not expected to be a concern, primarily because the highest demand would occur during the short-term construction phase and regions with low surface water availability are areas where groundwater use already dominates. The specific locations of each structure or access road have not yet been determined; therefore, the EIS does not identify which surface water features would be completely avoided or which could be affected by Project. Areas with the greatest amount of surface water in the ROW, such as Region 3 with the most perennial streams, reservoirs, lakes, and ponds, would be the most likely to potentially impact surface waters Operations and Maintenance Potential impacts would be minimal. The quantities of hazardous materials present (primarily fuels and lubricants in maintenance vehicles and equipment) would be much less than during construction, herbicides used to maintain ROWs and access roads would be applied in accordance with label instructions and any federal, state, and local regulations to minimize the potential for spreading, and water demands of facilities would be limited to that required to support the small number of employees.

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
Transportation	Construction Typical temporary impacts during construction include increased traffic from workers commuting to the construction sites, as well as increased traffic from the hauling of materials and equipment to the construction sites. Construction traffic also has the potential to impact bus and emergency routes for roadways near the construction areas. Temporary travel delays involving major roads (interstate highways, federal highways, and state highways) and railroads may also occur for HVDC transmission line installation at crossings. Construction activities that take place adjacent to major roadways also have the potential to cause temporary adverse impacts to traffic from vehicles entering and leaving the roadway and could involve lane closures. Roadway pavement or other infrastructure might be damaged by heavy vehicles delivering equipment and materials to construction areas. Transmission line structures and lines could become a hazard if they are located too close to airport operations or military airspace operating areas. River traffic may be controlled, in coordination with the USACE, during the short time required to span the conductor across Project construction activities have the potential to impact river traffic at the crossings of the Arkansas and Mississippi rivers. River traffic would not be impacted during Project operations and maintenance.
	Operations and Maintenance Long-term impacts are not expected because any increase in traffic during the operations and maintenance phase would be negligible. Transportation resources would be returned to previous operating conditions following construction.
Vegetation Communities	Construction Construction may cause the direct impact of vegetation removal and the indirect impacts of reduction of plant vigor from mechanical damage, fragmentation, and the introduction of invasive species. Impacts to vegetation may also vary in duration from short-term to long-term, with some impacts potentially permanent in nature. Removal of vegetation during construction may vary across the spectrum from short-term to permanent. Short-term removals and mechanical damage to vegetation may occur in areas of temporary construction access roads, construction laydown areas, and tensioning areas. It is likely that vegetation impacts in croplands would be short-term based on the seasonal replanting of these landscapes. Long-term to permanent impacts to vegetation would involve those areas of the ROW where vegetation is removed for new access roads and transmission structural foundations. Long-term impacts are also expected through those portions of the ROW with forested land cover due to the need to minimize canopy height for line safety. Long-term impacts may also result from vegetation removal in the portions of the Project ROW dominated by shortgrass prairie due to the difficulty of revegetation in drier climatic conditions. Operations and Maintenance Operation and maintenance of the Project is likely to impact vegetation directly through mowing and pruning in the ROW, and indirectly through herbicide applications that may impact non-target plant species.
Visual Resources	Construction Construction would result in the short-term visual intrusion of construction vehicles, equipment, materials, and a work force in staging areas, along access roads, and along the new transmission line ROW. Vehicles, heavy equipment, structure components, and workers would be visible during transmission line construction and modification, access and spur road clearing and grading, structure erection, conductor stringing, and cleanup and restoration. However, disturbance from construction activities would be transient and of short duration as activities progress along the transmission line route. Affected viewers would be aware of the temporary nature of Project construction impacts as well as existing structures in the area adjacent to the Project, which may decrease their concern to the impact. Operations and Maintenance Long-term impacts from the Project include the intrusion of transmission structures, access roads and cleared ROW that may introduce contrast into the surrounding landscape setting. Sensitive viewers in Regions 1, 2, and 6 that are characterized primarily by flat croplands and grasslands with scattered vegetation are anticipated to have greater visibility of the Project due to long viewing distances associated with an open landscape with panoramic views. In addition, the tall vertical geometric structures of the Project components would result in strong contrast with the relatively flat landscape with the regions. Sensitive viewers in Regions 3, 4, 5 and 7 that are characterized by varying terrain ranging from gently rolling to hilly to rugged with a greater occurrence of dense wooded areas are anticipated to have shorter viewing distances. Project components are more likely to be partially to completely screened by existing terrain and/or vegetation in all distance zones.

Table 2.6-3:
Summary of Potential Environmental Impacts—HVDC Transmission Line

RESOURCE	IMPACT
Wetlands, Floodplains, and Riparian Areas	Construction Potential impacts would primarily occur during construction. Short-term impacts may include mechanical damage/crushing of vegetation from use of heavy machinery, compaction of soils, sedimentation and turbidity from construction activities, alteration of hydrology from access road construction and excavations for structure foundations, contamination from herbicide runoff and from accidental spills of hazardous substances. Potential impacts are similar between the Applicant Proposed Route and the corresponding HVDC alternative routes. Some differences are apparent, however. For wetland resources, all HVDC alternative routes for Regions 2 and 3 have potential to impact more wetland acreage than the corresponding Applicant Proposed Route links in those regions. For floodplain resources, all HVDC alternative routes for Regions 2 and 7 contain more floodplain acreage and greater potential for impacts within the 200-foot-wide representative ROW as compared to Applicant Proposed Route links in those regions. Finally, all the HVDC alternative routes for Regions 2 and 4, and most of the HVDC alternative routes for Region 1 (except HVDC Alternative Route 1-C), Region 3 (except HVDC Alternative Route 3-C), and Region 6 (except HVDC Alternative Route 6-A), would cross more riparian area resources and have the potential for more impact acreage than the corresponding Applicant Proposed Route links. Operations and Maintenance The potential long-term impacts may include placement of fill at foundation footprint locations or for permanent access roads, long-term conversion of forested wetlands or riparian areas to shrubby or herbaceous cover types within the ROW, changes to hydrology from construction of permanent access roads or support structures and other ancillary infrastructure, and introduction of invasive species from construction equipment.
Wildlife and Fish	Construction Potential impacts would include direct mortality or injury of individuals from vegetation clearing, collisions with vehicles, potential exposure to hazardous materials (e.g., accidental spills and pesticides), wildfires, or increased predation rates; disturbance of suitable habitats or disruption of normal behaviors; and habitat loss or degradation (both temporary and permanent loss/degradation of habitat). Potential impacts to fish and aquatic invertebrate species would include direct mortality and injury of individuals (e.g., via crushing during crossing construction, sedimentation, potential exposure to hazardous materials, blasting); disturbance from suitable aquatic habitats or disruption of normal behaviors; aquatic habitat loss or degradation (both temporary and permanent loss/degradation of aquatic habitat); and introduction of non-native aquatic plants and animals. Operations and Maintenance Potential impacts include the fragmentation of habitats; isolation of sub-populations and loss of meta-population dynamics; degradation of habitat quality due to edge effects as well as invasive plant species; consolidation of predatory avian species along the line (e.g., raptors and corvids), and ongoing mortality of individual birds due to collision and electrocution risks. The majority of the Project would pass through and impact habitat types that contain low vegetation, which would typically recover quickly and would not need to be permanently cleared or maintained during the Project's operations and maintenance (e.g., grassland and cropland habitats). However, Regions 4 and 5, as well as Regions 3 and 7 to a lesser extent, would cross through and impact forested habitats. The Project would result in the permanent conversion of these forested habitats within the ROW to grasslands and/or shrublands (i.e., habitats that contain low vegetation types). This would constitute a permanent loss of forested habitats, as well as create a permanent edge effect along the Project's ROW in forested habitats. This could change the species composition and use of these once forested areas (i.e., transitioning to an edge habitat community). Potential impacts to fish and aquatic invertebrate species include mortality and injury of individual fish and aquatic invertebrates from sedimentation and potential exposure to hazardous materials (e.g., oils, fuels, herbicides); aquatic habitat degradation and loss from the presence of crossing structures, sedimentation, and non-native aquatic plants and animals; avoidance of aquatic habitats near project structures and roads; and temporary disturbance during maintenance activities.

2.7 Summary of Best Management Practices

As identified in Section 2.1.7, the Applicant has developed and would implement EPMs, included in Appendix F, to avoid or minimize effects to environmental resources from construction, operations and maintenance, and/or decommissioning, as appropriate. This EIS assumed the implementation of the EPMs throughout the impact analysis for each resource area in Chapter 3.

In addition, some resource sections also include best management practices (BMPs). For these resources, implementation of the EPMs would not be able to completely avoid or minimize all potential adverse effects resulting from construction, operations and maintenance, and decommissioning of the Project. In those instances, the following BMPs could be implemented to further avoid or minimize potential adverse effects. Table 2.7-1 provides a summary listing of the BMPs identified by each resource area analyzed in Chapter 3 (those resource areas that did not identify any BMPs are not included in the table). The Applicant has not committed to implementing BMPs though it is possible that certain BMPs will be required through the ROD or participation agreements.

Table 2.7-1:
Summary of Best Management Practices

RESOURCE AREA	BEST MANAGEMENT PRACTICE
Air Quality and Climate Change	• The quantity of sulfur hexafluoride (SF_6) emissions from maintenance activities (and potential leaks in equipment) would be minimized through the use of hermetically sealed equipment, leak detection programs, and sulfur hexafluoride recycling programs.
Geology, Paleontology, Minerals, and Soils	• If signs of contaminated soils are uncovered during construction activities, work would be stopped in the area of potentially contaminated soils until appropriate Project representatives could be consulted.
Health, Safety, and Intentional Destructive Acts	• Develop and implement a Health and Safety Plan that describes regulatory requirements, procedures, and practices for conducting activities to help ensure a safe working environment, which for purposes of health and safety measures should include: o Fire prevention, suppression, and emergency responder contact procedures o Natural disaster and severe weather reporting and contact procedures o Law enforcement contact procedures o Procedures for addressing hazardous materials spills and other mishaps • The Applicant will develop and implement a communications program. Section 3.1.2 describes the elements of this plan, which for purposes of health and safety should include: o Liaison and public outreach activities with local airports, aviation communities, aviation regulatory bodies, and aerial agricultural spraying operations o Local media and public outreach procedures for applicable hazard communication notices.
Land Use	• In existing forested areas where temporary work areas require tree clearing, replant temporary work areas with appropriate tree species. • In addition to EPM LU-5, make reasonable efforts to avoid displacing structures on private property.
Noise	• Investigate noise complaints in accordance with the Applicant's communications program.
Socioeconomics	• The Applicant will prepare and implement a workforce housing strategy that would minimize potential impacts to housing availability. This strategy would consider Project component construction schedules, workforce required, and other outside influences.
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	DOE and the Applicant are preparing a Biological Assessment of potential impacts on special status species protected under the ESA as part of the Section 7 consultation between DOE and the USFWS. The Section 7 consultation review is a parallel but separate process conducted pursuant to the requirements of ESA and the applicable implementing regulations. Through this process, additional protective measures may be identified and adopted to avoid and/or minimize impacts to special status species.
Transportation	• Accommodate existing and future planned transportation facility projects to the extent practicable into the final Project design and coordinate with appropriate jurisdictions to avoid or minimize disruptions to trails, streets, or drainage/irrigation structures.

Table 2.7-1:
Summary of Best Management Practices

RESOURCE AREA	BEST MANAGEMENT PRACTICE
	• In identified areas of traffic impact, conflicts between the Project traffic and background traffic such as movements of normal heavy trucks (dump trucks, concrete trucks, standard size tractor-trailers or flatbeds, etc.) would be minimized by scheduling (essential deliveries only) to the extent practicable during peak traffic hours/times and scheduling remaining heavy truck trips during off-peak traffic hours/times. • To the extent practicable, staging activities and parking of equipment and vehicles would occur primarily within private ROW on private land. • Implement the communications program described in Section 3.1.2.
Wetlands, Floodplains, and Riparian Areas	DOE, in consultation with the USACE, has identified the following BMPs: • In addition to protection of intermittent and perennial streams, ephemeral streams would also be included in the Applicant's streamside management zones. This BMP would add to EPM W-3. • Where tree removal is necessary in the ROW, this removal would be accomplished at ground level leaving root wads in place to aid in the stabilization of soils. • Limit, to the extent practicable, the amount of vegetation removed along streambanks and minimize the disruption of natural drainage patterns. • All permanent and temporary crossings of waterbodies would be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of aquatic species. The crossings would also be constructed to withstand expected high flows. The crossings would not restrict or impede the passage of normal or high flows. • Excavated trenches that are to be backfilled would separate the upper 12 inches of topsoil from the rest of the excavated material. The topsoil would be used as the final backfill.
Wildlife and Fish	For general wildlife and fish populations and habitat: • All vegetation clearing would comply with both state and federal spatial and timing windows, and would not occur during the avian breeding season applicable to each respective region. • Identify, control, and minimize the spread of non-native, invasive species and noxious weeds to the extent practicable, including ensuring that in-water equipment and vehicles are cleaned between waterbodies to minimize the chance of transferring non-native species between waterbodies. This BMP would expand EPM FVW-2.

2.8 Summary of Unavoidable Adverse Impacts

2.8.1 Definition

Unavoidable adverse impacts could occur during construction, operations and maintenance, and decommissioning of the Project. These impacts would be expected after implementation of the EPMs and those BMPs that DOE includes in a ROD or participation agreement; however, in all cases, the impacts would have been minimized through implementation of these measures. The following sections provide a brief summary of the unavoidable adverse impacts that could occur for each environmental resource area as provided in Chapter 3.

2.8.2 Agricultural Resources

Unavoidable adverse impacts could occur if the Project could not avoid agricultural structures. Yields from lands used for crops, pasture/hay, and grazing livestock would be temporarily affected in the construction areas, and land used for transmission structures, long-term access roads, and converter stations would be removed from agricultural production until the Project was decommissioned.

2.8.3 Air Quality and Climate Change

No unavoidable adverse impacts to air quality are anticipated to result from the Project.

2.8.4 Electrical Environment

Potential unavoidable adverse impacts to the electrical environment include the electrical effects (electric and magnetic fields, radio and television noise, audible noise, ozone, and air ions) associated with the operation of overhead HVDC and/or AC transmission lines. These effects are present within, and to a more limited extent outside of, the transmission line ROW. Outside of the ROW, calculated electrical effects for the Project are limited to levels that comply with associated standards and guidelines.

2.8.5 Environmental Justice

No unavoidable adverse impacts associated with environmental justice are anticipated to result from the Project.

2.8.6 Geology, Paleontology, Minerals, and Soils

2.8.6.1 Geology, Paleontology, and Minerals

Appropriate engineering design and adherence to applicable design standards would reduce the risk from geological hazards, but damage to Project components could occur if a rare, major geologic event such as a large magnitude earthquake or landslide occurred.

Despite EPMs and appropriate engineering design, scientifically valuable fossils may be disturbed and lost during construction activities. If this occurred, the small loss of fossil material would be offset to a degree by material that is recovered and preserved for scientific study purposes.

Mineral resources may exist directly underneath the route ROWs and/or converter station sites, in which case some resources could be less accessible for the life of the Project. The types of mineral resources that would be more affected are near-surface mineral material deposits (e.g., common sand, gravel, and stone). Oil and gas resources would be less affected because recovery of the resources would be possible, even with a minimum stand-off of 250 feet from the edge of the route ROWs and converter station sites using a vertically installed well, without the use of directional drilling. With directional drilling such areas could be accessed at considerable distance from the Project.

2.8.6.2 Soils

Removal of vegetation during construction grading and excavation activities could result in the exposure of soils to erosion and compaction of soils susceptible to compaction. Transmission line structures and converter station sites would permanently impact agricultural soils and remove them from productivity during construction and operations and maintenance. Access roads used during construction would temporarily remove agricultural soils from productivity, and the use of unpaved access roads during all Project phases could result in the exposure of soils to erosion and compaction. There would be potential depletion of soil productivity including erosion and loss of fertile topsoil, and potential erosion of exposed areas and compaction of areas traversed by equipment and vehicles.

2.8.7 Groundwater

Although the water needed for the Project is expected to come from municipal water systems, some of that municipal water would undoubtedly come from groundwater sources, so there would be a minor reduction in groundwater available for other uses or natural features while the construction took place.

Common materials present during construction would be considered groundwater contaminants were those materials to be spilled, leaked, or otherwise released and eventually reach groundwater. The potential for groundwater contamination is minor due to the EPMs and permitting requirements; however, the potential would not be eliminated.

2.8.8 Health, Safety, and Intentional Destructive Acts

There is a statistical possibility that accidents resulting in worker injuries and possibly death could occur during implementation of the Project. The hazardous nature of the work, the complexity of the electrical system, and the size and areal extent of the Project all would contribute to a potential for worker injuries or death and would be considered unavoidable adverse impacts. These unavoidable adverse impacts could be as a result of common personnel-involved injuries (e.g., slips, trips, or falls), hazardous materials or waste accidents, aircraft incidents, fire hazards, natural events or disasters, or intentional destructive acts.

2.8.9 Historic and Cultural Resources

DOE intends develop a Programmatic Agreement (PA) that will include assessment and resolution of effects, including avoidance, where practicable, and mitigation. Compliance with the PA and related plans would minimize unavoidable and adverse impacts to historic and cultural resources.

2.8.10 Land Use

Unavoidable adverse impacts to land uses from the Project include the removal of vegetation and conversion of primarily rangeland and cultivated crops and some forested lands and developed open space to a utility use. The Applicant Proposed Route would result in the conversion of up to approximately 2,600 acres of land to utility use for the life of the Project, including 2,394 acres for access roads (assuming 90 percent of them will remain after construction), 120 acres for two converter stations, 86 acres for all pole structures, and 2 acres for fiber regeneration sites.

Under the Applicant Proposed Route, 28 structures are present in the representative ROW: 2 residences, 2 commercial structures, 18 agricultural structures, 2 industrial structures, 2 abandoned structures, and 2 other structures. These structures would have to be removed if the Project features could not avoid them. Yields from cultivated crops, pasture/hay, and timberlands would be temporarily affected in the construction areas, and uses that are incompatible with the operation of the transmission line, such as tall trees for timber, would be removed from the ROW for the life of the Project.

2.8.11 Noise

Temporary noise impacts from construction activities would occur along the Project ROW. It is possible that EPA guidelines could be exceeded at some noise sensitive receptors from operations and maintenance of the AC and HVDC transmission lines.

2.8.12 Recreation

Unavoidable adverse impacts include the potential loss or alteration of recreational land and recreational uses of public or private lands that are located within the transmission line ROW because public access would be restricted at structure locations. Impacts to the setting of public recreational lands would be unavoidable and long-term, in recreational areas crossed by the Project.

2.8.13 Socioeconomics

No unavoidable adverse impacts to socioeconomic resources were identified.

2.8.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

2.8.14.1 Special Status Terrestrial Wildlife Species

Construction and operations and maintenance of the Project could result in the mortality of some special status wildlife species if they are present in the affected areas during these Project phases. Mortalities could include potential mortalities associated with the clearing of vegetation as well as avian collisions with Project structures during operations and maintenance. Potential mortalities would be highest if vegetation clearing was conducted during the breeding season. Construction-related disturbances to habitats could also result in degradation and loss of some wildlife habitats (through factors that include but are not limited to noise and visual disturbances, as well as the effects of fragmentation, edge effects, and invasive plant species). ROW maintenance in forested habitats as well as the footprint of Project structures would result in a permanent loss of mature forest habitats.

2.8.14.2 Fish, Aquatic Invertebrate, and Amphibian Species

Construction and operations and maintenance of the Project could result in the mortality and injury of some special status fish, aquatic invertebrate, and amphibian species if they are present in the affected areas during construction or operations and maintenance. Construction mortalities and injuries could result from crushing during waterbody crossings with equipment, sedimentation, potential exposure to hazardous materials, and blasting. Mortalities and injuries during operations and maintenance could result from sedimentation and potential exposure to hazardous materials. Unavoidable impacts to special status fish, aquatic invertebrate, and amphibian species and their habitat include the potential loss or alteration of aquatic habitat in streams that may require culverts or vehicle crossings, potential loss or disturbance to riparian vegetation along streams on private or public lands where the ROW is parallel and adjacent to the stream, and potential short-term sedimentation effects on aquatic resources as a result of vehicular traffic causing disturbances within or adjacent to streams.

2.8.15 Surface Water

The Project would require a moderate level of water use, and some access roads would likely traverse through or over stream channels. Sediment-laden runoff from a construction site could occur and could have adverse effects on a receiving water. The construction general permit for stormwater discharges would minimize the potential for such incidents and would keep potential adverse impacts to these surface waters to a minimum.

2.8.16 Transportation

Construction-related adverse impacts to local traffic would occur on roadways where materials and equipment are hauled to the construction areas. Construction activities associated with the crossing of roadways and railroads and potential encroachment along roadway ROWs would also result in unavoidable temporary impacts to roadways and traffic.

2.8.17 Vegetation Communities and Special Status Plant Species

Unavoidable adverse impacts to vegetation and special status plant species from the Project may include the following elements:

- Removal of vegetation in the footprints of new transmission line support structures, permanent access roads, converter stations, and other associated infrastructure
- Conversion of structural types of vegetation (e.g., forest conversion to grassland or forest to low-stature shrublands)
- Changes to plant species diversity with the general trend likely to be a diminishment of vegetation species diversity in disturbed areas
- Potential lower yields in croplands that are disturbed during construction and operations and maintenance

2.8.18 Visual Resources

Unavoidable impacts include the potential loss or alteration of sensitive views from public or private lands that are located within or adjacent to (within the foreground/middleground) the transmission line ROW or adjacent to converter station siting areas.

2.8.19 Wetlands, Floodplains, and Riparian Areas

Unavoidable adverse impacts to wetlands, floodplains, and riparian areas from construction and operations and maintenance of the Project could include:

- Removal of vegetation in the footprints of new transmission line support structures, access roads, converter stations, and other associated infrastructure, some of which may be wetland vegetation, or vegetation present in floodplains or riparian zones
- Conversion of vegetation structure (e.g., floodplain/riparian forest conversion to grassland/herbaceous or shrub/scrub land cover)
- Changes to species diversity within wetlands, floodplains, and/or riparian areas
- Changes in total cover percentage in wetland, floodplain, and riparian zone vegetation.

2.8.20 Wildlife, Fish, and Aquatic Invertebrates

2.8.20.1 Wildlife

Construction and operations and maintenance of the Project would result in the death of some wildlife species. Mortalities could result from the vegetation clearing activities as well as avian collisions with Project structures during operations. These mortality events would likely be highest if vegetation clearing is conducted during the breeding season. Construction-related disturbances to habitats would also result in degradation and loss of some wildlife habitats (through factors that include but are not limited to noise and visual disturbances, as well as the effects of fragmentation, edge effects, and invasive plant species). ROW maintenance in forested habitats as well as the footprint of Project structures would result in a permanent loss of habitats.

2.8.20.2 Fish and Aquatic Invertebrates

Unavoidable impacts include the potential loss or alteration of aquatic habitat in smaller streams that may require culverts or vehicle crossings, potential loss or disturbance to riparian vegetation along streams on private or public lands where the ROW is adjacent to the stream, and potential short-term sedimentation effects on aquatic resources as a result of vehicular traffic causing disturbances within or adjacent to streams.

2.9 Summary of Irreversible and Irretrievable Commitment of Resources

2.9.1 Definition

An “irreversible commitment of resources” occurs when, once committed to the Project, the resource would continue to be committed throughout the life of the Project but would become available again following decommissioning of the Project and restoration (if necessary). An "irretrievable commitment of resources" occurs when, once used, consumed, destroyed or degraded during construction, operations, maintenance, or decommissioning of the Project, the resource would no longer be unavailable for use by future generations. Such resources could not be restored, replaced, or otherwise retrieved for the life of the Project or thereafter. Examples of irretrievable types of resources include nonrenewable resources, such as minerals and cultural resources, as well as renewable resources that would be unavailable for the use of future generations such as loss of habitat that is not restored following or as part of decommissioning of the Project.

2.9.2 Agricultural Resources

Upon decommissioning of the Project, all land could return to previous uses. There would be no irreversible or irretrievable commitment of agricultural resources

2.9.3 Air Quality and Climate Change

No irreversible and irretrievable commitments of air quality resources are anticipated to result from the Project.

2.9.4 Electrical Environment

No irreversible and irretrievable commitment of resources associated with electrical effects is anticipated to result from the Project.

2.9.5 Environmental Justice

No irreversible and irretrievable commitments of resources associated with environmental justices are anticipated to result from the Project.

2.9.6 Geology, Paleontology, Minerals, and Soils

2.9.6.1 Geology, Paleontology, and Minerals

There would be no irreversible and irretrievable commitments of resources regarding geologic hazards. Because paleontological resources are nonrenewable, any impacts would render the resource disturbance irreversible and the integrity of the resource irretrievable. The short-term preclusion of access to some mineral resources would constitute an irreversible impact for the operational life of the Project.

2.9.6.2 Soils

An irreversible commitment of soil resources during the life span of the Project would occur until all transmission line concrete foundations, converter station facilities, and access roads were removed and successful reclamation was achieved for soils at the ground surface.

2.9.7 Groundwater

The Project would involve a commitment of groundwater resources, but at least to some extent, those resources would be replenished by cyclic seasonal recharge. The commitment of groundwater resources would be irreversible in that it would limit, in the short term, other options for use of that resource. Over time, however, the amounts of groundwater used to support construction would be expected to have a negligible effect on groundwater resources. In sum, the groundwater resource would be renewable or recoverable, so the commitment would not be considered irretrievable.

2.9.8 Health, Safety, and Intentional Destructive Acts

The health of workers and the public are important resources that must be protected. Through the implementation of safety plans, procedures, and required design elements, irreversible commitment of these resources would be kept to a minimum.

2.9.9 Historic and Cultural Resources

Cultural resources are nonrenewable. Adverse direct effects to these resources would constitute an irreversible and irretrievable commitment of resources. DOE will develop a PA that will include assessment and resolution of effects, including avoidance, where practicable, and mitigation. Compliance with the PA and related plans would minimize adverse direct effects to cultural resources. Any remaining adverse direct effects to cultural resources would represent an irreversible and irretrievable commitment of resources.

2.9.10 Land Use

The use of the approximately 2,600 acres for the life of the Project would be irreversible since some land use restrictions would result. Once the Project has been decommissioned, all land could return to previous uses; therefore, there would be no irretrievable commitment of land use resources.

2.9.11 Noise

With the implementation of EPMs and identified BMPs to resolve potential noise impacts to noise sensitive areas, no irreversible or irretrievable commitments of resources related to noise are anticipated.

2.9.12 Recreation

All impacts related to recreational resources would cease with the end of the Project and would not be irreversible or irretrievable.

2.9.13 Socioeconomics

No irreversible or irretrievable commitments of socioeconomic resources were identified.

2.9.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

2.9.14.1 Special Status Terrestrial Wildlife Species

The potential permanent loss or alteration of established trees in mature forests in the eastern portion of the Project (in Regions 3, 4, 5, and 7) would last throughout the life of the Project; however, gradual recovery of habitat may occur once the Project is decommissioned. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or weeds or pathogens may occur during the assumed 80-year lifespan of the Project), and mature forests are subject to long-term climatic regimes and it is reasonable to assume that some portions of the habitat for special status wildlife species in these forests would be irreversibly and irretrievably impacted.

2.9.14.2 Special Status Fish, Aquatic Invertebrate, and Amphibian Species

The potential permanent loss or alteration of aquatic habitat in smaller streams that may require road crossings would last throughout the life of the Project; however, gradual recovery of habitat may occur once the road crossing was removed. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or watershed hydrology may occur during the assumed 80-year lifespan of the project), and aquatic habitat is subject to long-term climatic regimes and changes in land-use and watershed hydrology, it is reasonable to assume that some portions of the aquatic habitat for special status fish, aquatic invertebrate, and amphibian species in these smaller streams would be irreversibly and irretrievably impacted.

2.9.15 Surface Water

The commitment of surface water resources would be irreversible in that it would limit, in the short term, future options for use of that resource. Over time, however, the amounts of water used to support construction would be expected to have a negligible effect on surface water resources. In other words, the surface water resource would be renewable or recoverable, so the commitment would not be considered irretrievable.

2.9.16 Transportation

As a result of the increased traffic associated with construction of the Project, a portion of the local roadway network capacity would be lost during the construction period. This loss would be irretrievable but short term. The use of non-renewable resources and resources that cannot be recycled would occur as a result of access roadway construction. The use of these resources would be irreversible.

2.9.17 Vegetation Communities and Special Status Plant Species

Both short- and long-term disturbance to vegetation would be reconciled through appropriate application of the Project's Restoration Plan. Once the Project has been decommissioned, there is potential for all of the approximately 2,600 acres of vegetation to be recovered. Therefore, it is predicted that there would be no irreversible or irretrievable commitment of vegetation resources.

2.9.18 Visual Resources

Irretrievable impacts to visual resources are anticipated where large trees are removed in the ROW, since trees would not be replanted or would be replanted and would result in age disparities, the effects of which would be noticeable to the casual observer.

Views of the transmission structures and converter stations for the life of the Project would be irreversible due to the introduction of structures and vegetative clearing. Once the Project has been decommissioned, all structures could be removed, access roads reclaimed, and vegetation restored; therefore, there would be no irreversible or irretrievable commitment of visual resources.

2.9.19 Wetlands, Floodplains, and Riparian Areas

The potential permanent loss or alteration of wetlands, floodplains, and riparian areas would last throughout the life of the Project; however, gradual recovery of these resources is expected after decommissioning. It is reasonable to assume that some wetlands, floodplains, and riparian areas may be irreversibly and irretrievably impacted.

2.9.20 Wildlife, Fish, and Aquatic Invertebrates

2.9.20.1 Wildlife

The potential permanent loss or alteration of wildlife habitat associated with established trees in mature forests in the eastern Project area (in Regions 3, 4, 5, and 7) would last throughout the life of the Project; however, gradual recovery of habitat may occur once the Project is decommissioned. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or weeds or pathogens may occur during the 80-year lifespan of the project), and mature forests are subject to long-term climatic regimes, it is reasonable to assume that some portions of the wildlife habitat in these forests would be irreversibly and irretrievably impacted.

2.9.20.2 Fish and Aquatic Invertebrates

The potential permanent loss or alteration of aquatic habitat in smaller streams that may require road crossings would last throughout the life of the Project, or at least through the duration of use of the access roads; however, gradual recovery of habitat may occur once the road crossing was removed and the stream restored to original conditions. As the exact state of this recovery is not known (e.g., substantial changes related to climate, land-use, and/or watershed hydrology may occur during the 80-year lifespan of the Project), and aquatic habitat is subject to long-term climatic regimes and changes in land-use and watershed hydrology, it is reasonable to assume that some portions of the aquatic habitat for fish and aquatic invertebrate species in these smaller streams would be irreversibly and irretrievably impacted.

2.10 Summary of Relationship between Local Short-term Uses and Long-term Productivity

2.10.1 Definition

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. In this EIS, short-term impacts are those impacts expected to occur during construction. Long-term impacts are those impacts expected to occur for some time during operations and maintenance. Permanent impacts are those that would be expected to continue even after decommissioning of the Project. The potential impacts to the environment from all phases of the Project could be minimized through the implementation of the EPMs and BMPs identified in Appendix F and Section 2.7, respectively. The following sections provide a brief summary of the relationship between local short-term uses and long-term productivity for each environmental resource area as provided in Chapter 3.

2.10.2 Agricultural Resources

The conversion of primarily agricultural land to a utility use to construct and operate the Project would result in short-term use impacts. These direct effects would include the loss of crops pasture/hay and grazing land for livestock in the representative ROW as well as loss of agricultural structures. Other short-term and localized impacts include the disruption of access to local agricultural land uses during construction. The productivity of the soil in temporary construction areas may also be reduced due to compaction and soil erosion.

2.10.3 Air Quality and Climate Change

Emissions from construction of the Project are not predicted to impact sensitive receptors and also would not impact long-term productivity. While over the short-term emissions from construction would be higher in localized areas—because the Project provides for development of non-fossil fuel energy sources over the long term—air quality would be improved in comparison to not building the Project.

2.10.4 Electrical Environment

No short-term uses or resource removal exist that would affect long-term productivity associated with electrical effects from the Project.

2.10.5 Environmental Justice

Because the EIS did not identify any disproportionately high and adverse impacts to low-income or minority populations, there would be no long-term impact to these populations.

2.10.6 Geology, Paleontology, Minerals, and Soils

2.10.6.1 Geology, Paleontology, and Minerals

No relationships exist between local short-term uses and long-term productivity for geological hazards. Short-term impacts associated with the exposure of any scientifically important fossils from Project activities would not adversely impact the long-term potential for discovery of potential fossil resources. Any short-term effects are not expected to cause long-term impairment to the productivity of mineral resources.

2.10.6.2 Soils

Overall site productivity is primarily a matter of revegetation/reclamation success and availability for agricultural or other uses. Impacts to short-term uses of soil resources would result from construction and operations and maintenance of the Project, while impacts to long-term productivity would depend on the success of the reclamation activities. Short-term impacts are associated with land areas directly affected by construction and operations and maintenance of the Project. Short-term impacts include the construction and use of access roads during the construction phase of the Project and the use of access roads for operations and maintenance. Other short-term impacts to soil resources could occur at the footprint areas of construction work areas, converter station sites, transmission line structures, fiber optic sites, and construction tensioning and pulling areas. These areas could all be returned to other productive uses following decommissioning. A decrease in the long-term productivity of soils would result if soils were not reclaimed to their existing quality condition including such characteristics as aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics that are accepted as beneficial to overall plant growth and establishment.

2.10.7 Groundwater

Groundwater required to support the Project would represent a new, short-term use of the resource, but would have negligible effect on its long-term productivity.

2.10.8 Health, Safety, and Intentional Destructive Acts

While there would be a short-term temporary increase in potential health and safety impacts associated with construction, long-term impacts in the region would not increase and would not affect the productivity of the region.

2.10.9 Historic and Cultural Resources

The impacts associated with short-term use of the environment for cultural resources would likely be minor as DOE intends to develop a PA that will include assessment and resolution of effects, including avoidance, where practicable, and mitigation.

2.10.10 Land Use

Local short-term use effects from the Project would result from the removal of vegetation and conversion of primarily agricultural and undeveloped land to a utility use. Other short-term and local impacts include the disruption to access to local land uses that may occur, such as agriculture, oil and gas development, and residences and businesses during construction.

2.10.11 Noise

Construction noise would temporarily impact nearby noise sensitive areas; noise levels associated with operations and maintenance of the Project would not impact long-term productivity. Changes in sound level associated with the Project would not be expected to negatively impact current land use and activities.

2.10.12 Recreation

Some direct short-term impacts to resources such as noise or visual disturbance, or restricted access to the recreation area during construction, would likely diminish the quality of a recreational visit. Long-term productivity of recreational areas could potentially decrease in recreational areas that were crossed by the Project.

2.10.13 Socioeconomics

Potential short-term impacts to socioeconomic resources are not expected to outweigh the long-term benefits of the Project. In the long term, the Project would be expected to increase economic productivity through the delivery of renewable energy generated in the Oklahoma and Texas Panhandle regions to load-serving entities in the mid-south and southeast regions of the United States.

2.10.14 Special Status Wildlife, Fish, Aquatic Invertebrate, and Amphibian Species

2.10.14.1 Special Status Terrestrial Wildlife Species

The Project could result in a short-term disturbance to special status wildlife; however, these impacts should not affect the long-term productivity of populations of special status wildlife.

2.10.14.2 Special Status Fish, Aquatic Invertebrate, and Amphibian Species

The Project may result in a short-term disturbance to special status fish, aquatic invertebrate, and amphibian resources; however, these impacts would not likely affect the long-term productivity of populations of special status fish, aquatic invertebrate, and amphibian species.

2.10.15 Surface Water

Surface water required to support the Project would represent a new, short-term use of the resource, but would have negligible effect on its long-term productivity. Any alterations to streambeds required by access road construction would have short term impacts on the altered segment of stream, but over time the impacts would be expected to fade as natural flora and fauna re-established and the impacted stream segments would be small.

2.10.16 Transportation

Construction of the Project would increase the short-term uses of the local roadway network during construction but would have no impact on long-term productivity because roadways would be returned to their original condition and travel conditions would neither improve nor deteriorate during the operational life of the Project.

2.10.17 Vegetation Communities and Special Status Plant Species

The impact of short-term uses on long-term productivity to vegetation resources would be limited to those areas where (1) structural foundations are left in place until decommissioning, or (2) instances where vegetation structure is altered from forested to herbaceous structural types. In this second specific case, the functions of wildlife habitat maintenance, biodiversity, and recreational opportunities could be diminished.

2.10.18 Visual Resources

Short-term vegetation management may impair long-term visual resources where trees or areas of thick vegetation are removed and take years to grow back.

2.10.19 Wetlands, Floodplains, and Riparian Areas

The Project would result in a short-term disturbance to wetlands, floodplains, and riparian areas; however, these impacts should not affect the long-term productivity of these resources.

2.10.20 Wildlife, Fish, and Aquatic Invertebrates

2.10.20.1 Wildlife

The Project may result in a short-term disturbance to wildlife resources; however, these impacts should not affect the long-term productivity of populations of wildlife resources.

2.10.20.2 Fish and Aquatic Invertebrates

The Project would result in a short-term disturbance to aquatic resources; however, these impacts should not affect the long-term productivity of populations of fish and other aquatic species. The short-term impact of introducing non-native invasive species would be negligible; however, over time, long-term productivity would be affected and species could be eliminated from their native habitat.

2.11 Summary of Impacts from Connected Actions

The following sections provide a characterization of the potential connected actions associated with the Project. Descriptions of these connected actions are provided in Section 2.5.

2.11.1 Wind Energy Generation

As described in Section 2.5.1, wind power facilities that would interconnect with the Project are anticipated to be located in parts of the Oklahoma Panhandle and Texas Panhandle within an approximate 40-mile radius of the western converter station. The Applicant anticipates future wind farm development to be between 4,000 and 4,550MW. Neither the Applicant nor DOE knows the exact location of wind power facilities that would be connected to the Project. The Applicant has identified 12 wind development zones (WDZs) based on available wind resources and existing land uses. The range of potential impacts across these WDZs is presented in Table 2.11-1.

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
Agricultural Resources	Construction Approximately 2% of land within a wind energy facility would be disturbed, typically primarily cropland and grasslands. As indicated in Section 3.2.6.8.1, assuming between 20 and 30% of the WDZs would be built-out, between 4,328 and 6,492 acres of primarily agricultural land would be temporarily affected during construction. Wind farm developers are typically able to micro-site turbines and other facility components to avoid displacing or damaging agricultural structures such as irrigation equipment, barns, and silos. Operations and Maintenance Approximately 1% or less of the land for a wind energy facility would be affected or disturbed (converted to utility use for life of the project). For the 12 WDZs, assuming 20 to 30% build-out, between 2,164 and 3,246 acres of primarily agricultural land would be affected for the life of the wind energy facilities. Agricultural uses may usually resume around the facility once construction has been completed.
Air Quality and Climate Change	Construction Minor temporary impacts from construction emissions and are not expected to contribute to substantially increased air pollutant concentrations. Operations and Maintenance Reduction in emissions of pollutants and greenhouse gases from the displacement of current fossil fuel power sources for electricity generation.
Electrical Environment	Construction/Operations and Maintenance None expected.
Environmental Justice	Construction/Operations and Maintenance None expected.
Geology, Paleontology, Soils, and Minerals	Construction Potential impacts to karst and to paleontological resources if shallow bedrock disturbed. Complete avoidance of karst is not possible, and the risk to wind farm components from subsidence would still exist. Impacts on mineral resources extraction during construction are anticipated to be minor. Specific locations of wind generation facilities are not known at this time and therefore specific impacts to designated farmland, soil limitation parameters, or

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
	contaminated soil cannot be determined. Based on the general characteristics of the WDZs, some affected soils may be susceptible to compaction or have moderate to high wind erosion potential. The remaining soil limitation characteristics are not prominent in the WDZs. Operations and Maintenance Due to the prevalence of karst in the area, the risk for subsidence does exist. Impacts from subsidence in karst areas can be avoided and minimized during engineering design. Impacts to mineral resource accessibility would not be expected if protective measures described for the construction phase were put in place, and the locations of the facilities would be designed to avoid mineral resources to the extent possible. Impacts to designated farmland, and soils within infrastructure footprints, including turbine footprint areas, collector lines, substations, met towers, operations and maintenance buildings, and access roads for the maintenance and operations of these facilities.
Groundwater	Construction Common impacts include (1) minor potential for contamination from spills or leaks of fuels and lubricants, (2) small and short-term changes in infiltration rates in areas of land disturbance that would not be expected to result in any noticeable changes in the area's natural groundwater recharge rates; (3) minor impacts to water availability from groundwater demands for soil compaction during road, substation, and wind turbine foundation construction and for dust suppression, and (4) potential damage to wells and associated piping systems in construction areas. Operations and Maintenance Groundwater use would be minor; (limited to personal needs of the few workers associated with maintenance of facilities and equipment) no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, no impacts expected.
Health, Safety, and Intentional Destructive Acts	Construction Lost-time accident and fatality risks to workers typical of large construction projects. Aircraft operations, including helicopter use, could pose collision risks. Operations and Maintenance Minor potential for rotor blade failure and ice buildup and throw from blades during freezing weather conditions. Impacts typically remaining within the wind generation facility site or transmission line ROW. Potential for shadow flicker and blade glint and glare to cause annoyance to workers and public within range of wind energy generation structures.
Historical and Cultural Resources	Construction Ground disturbance has the potential to disturb belowground historical and cultural (archaeological) resources if present. The level of potential adverse impacts to cultural resources associated with wind energy generation would depend on the level of archaeological surveys conducted and the associated cultural resources BMPs and mitigation plans implemented by wind energy developers. Operations and Maintenance No additional impacts expected.
Land Use	Construction Disturbance of approximately 2% of land within an individual wind energy facility, typically primarily cropland and grasslands. Assuming between 20 and 30% of the WDZs would be built out, between 4,328 and 6,492 acres would be temporarily disturbed (2% of the 20% for the low end, 2% of the 30% for the high end.) Operations and Maintenance Approximately 1% of land within a wind energy facility is converted to utility use for life of the project. For the 12 WDZs, assuming 20 to 30% build-out, between 2,164 and 3,246 acres would be disturbed (until decommissioning). Temporary construction acres would revert to their previous use. Only turbines, access roads, generation tie-lines (if necessary), substations, and operations and maintenance buildings would remain. Agricultural uses and oil/gas development may usually resume around the facility.

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
Noise	Construction Noise sensitive areas near wind energy facilities could experience temporary elevated sound levels from motorized construction equipment used for general construction. Operations and Maintenance Noise from operation of wind energy generation facilities would result from the operation of wind turbines, and maintenance of the wind energy developments. Because there are no site-specific plans for the wind energy development areas, it is not possible to analyze noise impacts for each potential wind energy generation development area. As wind development projects are established in the WDZs, each would be required to proceed through state, local, and other permitting efforts as applicable.
Recreation	Construction Noise, dust, and human activity, as well as vegetation clearing and turbine erection would cause short-term reduced access to, or enjoyment of, recreational areas. No recreational areas are present in WDZ-C, E, F, G, H, I, J, and K, so no impacts are expected in those WDZs. It is assumed that wind energy developers would likely site wind farms to avoid direct impacts to parks and municipalities. Operations and Maintenance Long-term impacts to recreation would typically be limited to changes in the visual characteristics of a recreational area.
Socioeconomics	Construction Construction would result in a range of estimated total (direct, indirect, and induced) jobs of between 8,762 and 9,910 in Region 1. Construction would also result in a range of estimated total (direct, indirect, and induced) earnings of between $435 million and $494 million. Temporary housing impacts could occur if wind generation construction is concurrent with construction of the Project in Region 1 because housing is more limited in this region. Estimated state sales and use tax revenues would range from $158 million to $161 million in Oklahoma and from $217 million to $223 million in Texas. For the three Oklahoma counties, estimated county sales and use tax revenues per facility would range from $0.9 million to $1.9 million for a 50MW facility and from $17.9 million to $35.7 million for a 1,000MW facility.
	Operations and Maintenance Operations and maintenance would result in a range of estimated total (direct, indirect, and induced) jobs of between 665 and 798. Operations and maintenance would also result in a range of estimated total (direct, indirect, and induced) earnings of between $32.9 million and $41.2 million. These annual impacts would occur each year for the operating life of the potential wind facilities. Positive tax revenue impacts would be expected from annual ad valorem or property taxes. For potentially affected counties in Oklahoma, the tax revenues for a single wind facility would range from $1.9 million (for a 50MW facility in Beaver County) to $36 million (for a 1,000MW facility in Texas County). For potentially affected Texas counties, the property tax revenues for a single wind facility would range from $4.3 million (for a 50MW facility in Hansford County) to $85.6 million (for a 1,000MW facility in Sherman County).
Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species	Construction Potential impacts during wind farm development could include short-term disturbances to species (i.e., displacement in the vicinity of construction activity) during construction, loss of habitat from land disturbance, and potential mortality from vehicle collisions. Potentially suitable habitat for piping plover is limited; however, there is a potential for piping plover to occur during migration. LEPC and whooping crane may feed within the croplands and grasslands; however, the whooping crane occurrence is likely to be limited to migratory and stopover occurrences. The LEPC habitat within some zones is categorized as CHAT category 1 (i.e., focal area) suggesting that large areas of undeveloped, contiguous grassland/herbaceous land cover occur. The LEPC could be potentially impacted during construction of wind farms by clearing of grassland habitats for access roads, wind turbines, and electrical stations. Specifically, the potential for construction impacts to the LEPC and its habitat is greater in WDZ-D, -I, -J, -K, and -L. These WDZs occur in eastern Texas County and western Beaver County in Oklahoma and western Ochiltree County in Texas. Potential mortality and injury, disturbance, and aquatic habitat loss and modification impacts to the Arkansas darter and Arkansas River shiner could occur in WDZ-J and WDZ-K.

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
	Operations and Maintenance Migrant bald and golden eagles and whooping cranes could be at risk for mortality collisions with the turbines. Behavioral avoidance by LEPC of otherwise suitable habitat surrounding wind turbine towers could be possible. Specific impacts would be dependent on the eventual location of the wind energy facilities. Potential impacts to the Arkansas darter and Arkansas River shiner would be similar to those from construction.
Surface Water	Construction Common impacts include (1) potential for runoff and receiving water contamination from spills or leaks of fuels and lubricants, (2) small and short-term changes in runoff rates in areas of land disturbance, and (3) possible disturbance of drainage features, including intermittent or perennial streams, from construction of access roads. Operations and Maintenance Water use would be minor; no impacts expected. Compared to pre-wind farm conditions, long-term operations and maintenance of wind farms in any of the WDZs would only result in minor changes to stormwater runoff and drainage.
Transportation	Construction: Impacts to roads would be minor, short term and temporary, most roads have the potential for one-level decreases to level of service. Level of service would not decrease below LOS-C even in the unlikely scenario where 38 wind farms and the AC collection system are under construction within 1 year, which further supports the conclusion that impacts during construction would be minor and temporary. Although railroads, airports, airstrips, and navigational aids are located within the WDZs, impacts to these features from construction are not expected. Operations and Maintenance Low level of increased rural traffic from wind farm workers and their families. FAA lighting requirements would apply to the wind turbines. In addition, the heights of the turbines would require careful selection of specific turbine sites to avoid potential conflicts with airports and military airspace. In some cases, FAA notification requirements might be triggered.
Vegetation Communities	Construction Approximately 2% of land within any wind energy facility is assumed to be disturbed during construction, equating to approximately 6,492 acres of temporary disturbance. All of the potential wind generation areas are dominated by cropland and grassland land cover types. Temporary impacts during construction may result from increased dust entrainment that can settle on surrounding vegetation causing a reduction in photosynthetic capability of plants. It is also likely that there would be mowing or potential removal of vegetation in ROWs for generation tie-lines, access roads, and electrical collection lines that are placed underground. Long-term to permanent impacts may result to vegetation where it is removed to facilitate construction of substation facilities. Operations and Maintenance Approximately 1% of land within any given wind energy facility is anticipated to be impacted by maintenance and operations. This would equate to approximately 3,246 acres. Once construction has been completed, agricultural operations would be able to continue in most of the wind farm. Agricultural activities such as cultivating crops are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be permanently removed from production. Permanent access roads may change the configuration of fields for crops.
Visual Resources	Construction Short-term visual intrusion of construction vehicles, equipment, materials, and work force in staging areas, and final turbine location. Operations and Maintenance The tall, vertical wind turbines would be in strong contrast with the primarily horizontal lines of the surrounding landscape; therefore, higher impacts are anticipated where the wind turbines are located in the foreground and near middle ground in relation to sensitive viewers. In addition, the required FAA lighting would be visible for long distances and would likely attract attention when flashing. Most of the highly sensitive resources, such as the national grassland and recreation areas, however, would be located in the background distance zone, so impacts would not be as strong as turbines would not be a dominant feature at that distance.

Table 2.11-1:
Summary of Impacts from Wind Energy Generation

RESOURCE	POTENTIAL IMPACTS
Wetlands, Floodplains, and Riparian Areas	Construction The potential short-term impacts from construction activities for wind energy generation could include mechanical damage/crushing of wetland and riparian vegetation, compaction of soils, sedimentation and turbidity from construction activities adjacent to these resources, alteration of hydrology from access road construction, dewatering activities, and contamination from accidental spills of hazardous substances such as fuels and lubricants. The potential long-term impacts to wetlands, floodplains, and riparian resources could include removal of vegetation during excavations for structure foundations, electrical collection lines, or during permanent access road construction, conversion of forested wetlands and riparian areas to shrubby or herbaceous cover types within the ROW, changes to hydrology from permanent access roads construction, and the introduction of invasive species from construction equipment. Operations and Maintenance There would be a potential for impacts from contamination from accidental spills of hazardous substances such as fuels and lubricants, however, the potential would be less than during construction.
Wildlife and Fish	Construction Short-term impacts to wildlife resources during construction may include disturbance due to increased noise, dust, and traffic. Additionally, there is the potential for short-term indirect impacts to wildlife habitats as a result of the clearing of vegetation and soil disruption during construction. There is the potential for long-term, direct habitat loss related to construction of a wind energy development. Potential localized aquatic habitat damage, sensory disturbance, and mortality/injury to fish and aquatic invertebrate species could occur at stream and water body crossings. Operations and Maintenance Operations and maintenance of wind energy developments are known to have direct impacts on some wildlife species, specifically avian and bat species, due to collisions with wind turbine blades, collisions and electrocutions associated with generation tie-lines, and barotrauma of bat species. Permanent habitat loss would occur due to the footprint of the project. Potential impacts to fish and aquatic invertebrate species similar to those during construction could occur during maintenance activities at stream and river crossings.

2.11.2 Optima Substation

The future Optima Substation is anticipated to be constructed on 160 acres of currently undeveloped land near an operating wind energy facility. The land cover of the site is primarily grassland/herbaceous. Any agricultural practices, such as grazing, that currently occur on the site would be converted to a utility use. The site would be partially contained within the Oklahoma AC Interconnection Siting Area. Therefore, impacts of this connected action would be similar, but of a smaller scale, to the impacts presented for the Oklahoma Converter Station and Interconnection Siting Area. Impacts would occur primarily during construction of the substation because there would be few, if any environmental impacts associated with operations and maintenance of the substation.

2.11.3 TVA Upgrades

The required TVA upgrades could have impacts similar to the Project, but on a smaller scale, being restricted to an approximately 37-mile-long new 500kV AC transmission line in western Tennessee and upgrades to existing facilities. The potential impacts would be limited primarily to the construction phase of the required upgrades. The upgrades to existing facilities would be unlikely to result in any significant, adverse impacts since there would not likely be any additional land disturbance required beyond the existing footprint of those facilities. The specific impacts of the new transmission line would be subject to environmental review once specific locations are identified. TVA anticipates tiering from this EIS when completing its review of potential environmental impacts as required by NEPA.

2.12 Summary of Impacts from the No Action Alternative

Under the No Action Alternative, DOE would not participate with the Applicant in the Applicant Proposed Project or DOE Alternatives. DOE assumes for analytical purposes that the Project would not move forward and none of the potential environmental effects associated with the Project would occur. Therefore, the Project would not be constructed and no additional impacts would occur to any of the environmental resources analyzed.

2.13 Summary of Cumulative Impacts

The cumulative impacts analysis identified past, present, and reasonably future actions that could occur within the same time and place as the Project. This section identifies those cumulative impacts for both construction and operations and maintenance. Chapter 4, Cumulative Impacts, describes the identification of past, present, and reasonably foreseeable future actions in detail and provides an evaluation of potential cumulative impacts.

Impacts from Construction

Construction activities in the seven diverse regions of the Project could result in impacts to agricultural resources, changes to land uses, temporary land disturbance, increased traffic, increased air emissions, increased noise levels, intrusions into the visual landscape, and potential impacts to wildlife, fish, aquatic invertebrate, and amphibian species and vegetation, including special status species. In most cases, the impacted areas would begin to return to their original state within months after construction activities have been completed. Cumulatively, other construction activities occurring in the same time and vicinity would have similar impacts on the specific ROIs within each region. Other past, present, and reasonably foreseeable actions identified for the seven regions that could occur within the same time and place of the Project include electrical transmission lines, roadway and bridge enhancements, new road construction, oil or natural gas pipelines, wind farm developments, and two relatively large development projects in Region 7 (Great River Super Site and Green Meadows Development; see Table 4.2-1a in Chapter 4). Multiple activities occurring at the same time and vicinity would have greater impacts than just one action. If construction activities overlapped in the same area, then the construction-related impacts could be greater than for just the Project. However, with the exception of the converter stations, construction of the Project would not affect any one area for long (i.e., no more than a few weeks or months), so the short temporal overlap would limit cumulative impacts. The majority of the actions identified are transmission lines and road construction. Most of the road construction would occur on existing roadways, not disturbing new lands, and therefore would have only minor contributions to cumulative impacts from the Project. Overall, construction of the Project, when considered with past, present, and reasonably foreseeable actions, would result in the following cumulative impacts: short-term, temporary disturbance of active agricultural lands and operations; possible restrictions on existing land uses; temporary soil and vegetation disturbance; increased risk of localized water quality impacts (spills or sedimentation); increased traffic; increased air emissions and noise levels; potential shortages in temporary housing (in Region 1); visual disruptions from construction equipment and land disturbance; and potential impacts to wildlife, fish, aquatic invertebrate, and amphibian species and vegetation, including special status species. Fish special status species are the Arkansas darter, Arkansas River shiner, Ozark cavefish, Yellowcheek darter, and pallid sturgeon. The aquatic invertebrate special status species are spectaclecase, pink mucket, Neosho mucket, speckled pocketbook, scaleshell mussel, fat pocketbook, rabbitsfoot, snuffbox, and Curtis' pearlymussel. The special status amphibian is the Ozark hellbender.

Impacts from Operations and Maintenance

After completion of construction, the majority of the Project-related impacts would be minimized. Those that would continue or increase would include electrical environment (electric fields, magnetic fields, audible noise, and radio and television interference) and visual resources. The Project individually would not be considered a strong source of magnetic fields. Other existing and proposed transmission lines that would be crossed by the Project would be an additional source of magnetic fields at the location of the crossing. People are exposed to numerous sources of magnetic fields on a daily basis from sources like power lines, but also from electric devices in home and office environments. The research available on the health impacts of magnetic field exposure are not definitive, and no conclusions regarding the health impacts can be drawn based on what is presently known about the health impacts of magnetic fields.

Long-term visual impacts from the Project include the intrusion of the converter station and associated structures and transmission structures, access roads, and cleared ROW that may introduce contrast into the surrounding landscape setting. The cumulative impacts would be of a similar nature in areas where additional transmission line actions have been identified (Regions 1, 2, and 3). Additionally, sensitive viewers in Regions 1, 2, and 6 that are characterized primarily by flat croplands and grasslands with scattered vegetation are anticipated to have greater visibility of the Project due to long viewing distances associated with an open landscape with panoramic views. A new planned section of Highway 71 would cross Link 6 of the Region 4 Applicant Proposed Route and near the Alma Key Observation Point. The visual impacts of the new section of Highway 71 would be cumulative over the long-term with those of the Project.

2.14 Agency Preferred Alternative

CEQ regulations at 40 CFR 1502.14(e) require an agency to identify its preferred alternative, if one exists, in the Draft EIS. At this point in the NEPA process, DOE does not have a preferred alternative. DOE has not identified a preference for whether to participate with Clean Line in some manner as prescribed by Section 1222 of the EPAct. As part of its deliberations, DOE will consider all of the alternatives analyzed in the Draft EIS and take into consideration the comparison of potential impacts for each resource area coupled with input received during the public comment period on the Draft EIS. DOE will identify its preference for whether to participate with Clean Line and its preferred alternatives for each of the project elements (including route alternatives) in the Final EIS.

As identified in Section 2.4.3.2.4, DOE analyzed HVDC Alternative Route 4-B, which would intersect the Ozark National Forest in Crawford County, Arkansas. The representative ROW for HVDC Alternative Route 4-B crosses approximately 387 acres of the Ozark National Forest (230 of which are federally owned), while other alternative routes in Region 4 do not. (A small portion, 2.5 acres, of the representative ROW for the Applicant Proposed Route overlaps the Ozark National Forest, however, this could potentially be avoided during final siting of the Project within the analyzed 1,000-foot-wide corridor for the Applicant Proposed Route.) After detailed analysis and discussion with the USFS, DOE has determined that HVDC Alternative Route 4-B is not a preferred alternative.

DOE and Clean Line considered constraints and routing criteria when developing a route alternative to cross National Forest land (DOE 2013). DOE consulted with USFS and determined that HVDC Alternative Route 4-B struck a balance between minimizing potential environmental impacts to private and public lands, while still allowing the construction of the Project. The primary reasons that HVDC Alternative Route 4-B is non-preferred include the following:

- The route alternative would adversely affect sensitive resources by creating discontinuities (linear breaks) in National Forest land (Section 3.10.6).
- The route alternative would cross lands designated as High Scenic Integrity Objectives as identified in the USFS' Forest Plan (Section 3.18.6).
- Required ROW maintenance along the route alternative would adversely affect timber production (see Section 3.10.6).
- The route alternative would, in places, undermine the use for which the National Forest land was originally acquired (i.e., conservation of natural resources) (Section 3.10.6).
- The route alternative would, in places, traverse steep, rugged terrain that could present an increased safety hazard during construction and future maintenance of an HVDC transmission line (Section 3.8.5.3).
- The route alternative is close to the Ozark Plateau region, which contains cave hibernacula for special status bat species. The increase in forested land in this area increases the potential for impacts to the special status bat species (e.g., disturbances to or loss of roost trees) compared to routes that do not cross the Ozark National Forest (3.14.1.7).
- The route alternative would cross into the Ozark National Forest Important Bird Area (identified by National Audubon Society), potentially indirectly impacting wildlife species (Section 3.20.1.7.3).
- The interspersed land cover and land ownership along the route alternative suggests that a variety of land uses may occur along the ROW, and as a result, a variety of wildlife species common to both deciduous forests and pasture/hay land covers may occur in this area (thereby potentially exposing more wildlife species to project related impacts compared to the Applicant Proposed Route) (Section 3.20.1.7.3).
- To the extent that the route alternative might have the benefit of avoiding private land, that benefit is limited because the route alternative would also cross a large number of parcels of privately owned land within the National Forest boundary (Section 3.10.6).[5]

[5] Privately owned land, or inholdings, can occur inside the boundary of a National Forest. Inholdings result from private ownership of lands prior to the designation of the National Forest, which then end up grandfathered within the legally designated boundary.

Contents

Tables

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3. Affected Environment and Environmental Impacts

3.1 Introduction

3.1.1 Region of Influence

The Project covers approximately 720 miles of diverse landscape and therefore is divided into seven geographic regions. These regions are discussed in Section 2.4 and were established as part of the route development and identification process and have been carried through to the environmental analysis phase of the Project so that the existing conditions and environmental impacts could be analyzed within geographic areas that have similar characteristics. Figures 2.1-17a though 2.1-17f (located in Appendix A) provide an illustration of the Project components throughout the regions. Consistent with Section 1222 of the EPAct, DOE's participation in the Project would be limited to states in which Southwestern operates; namely Oklahoma, Arkansas, and possibly Texas, but not Tennessee. Consequently, DOE will not participate in the portions of the Project that would be located in Tennessee. This EIS does, however, evaluate the environmental impacts of the Project in Tennessee.

This chapter describes the baseline environment of the areas that could be affected by the Project and analyzes the potential environmental impacts that may result from construction, operations and maintenance, and decommissioning of the Project. To examine the potential impacts of the Project components, the EIS examines the area potentially affected by the Applicant Proposed Project and the DOE Alternatives. The EIS defines the area potentially affected by the Project as the region of influence (ROI). The ROI extends beyond the physical dimensions of the HVDC and AC transmission ROWs and converter station footprints. The ROI for the Applicant Proposed Project consists of the following:

- Oklahoma Converter Station Siting Area: An approximate 620-acre area in Texas County, Oklahoma, within which the Applicant proposes to site the Oklahoma converter station and associated AC switchyard (45 to 70 acres total) and access road(s).
- Oklahoma AC Interconnection Siting Area: An approximate 870-acre corridor within which the Applicant proposes to site an AC transmission interconnection route from the Oklahoma converter station to the future Optima Substation.
- AC Collection System: Thirteen 2-mile-wide corridors in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties) within which the Applicant anticipates that the AC Collection System could be sited.
- Tennessee Converter Station Siting Area: An approximate 740-acre area located partially in Shelby County and partially in Tipton County, Tennessee, within which the Applicant proposes to site the Tennessee converter station and associated AC switchyard (45 to 70 acres total), access road(s), and the AC transmission interconnection from the Tennessee converter station to the existing Shelby Substation.
- HVDC Applicant Proposed Route: A 1,000-foot-wide corridor within which the Applicant proposes to site the ROW for the HVDC transmission line between the Oklahoma converter station and the Tennessee converter station.

The ROI for the DOE Alternatives consist of the following:

- Arkansas Converter Station Alternative Siting Area: An approximate 20,000-acre siting area located partially in Pope County and partially in Conway County, Arkansas, within which the Arkansas converter station and associated AC switchyard (45 to 60 acres total) and access road(s) could be sited.
- Arkansas AC Interconnection Siting Area: A 2-mile-wide corridor within which one or more potential AC transmission line route(s) could be sited from the Arkansas converter station to an interconnection point(s) (5 acres) to an existing 500kV transmission line.
- HVDC Alternative Routes: A series of 1,000-foot-wide corridors that DOE has proposed as alternatives to the HVDC Applicant Proposed Route within which the ROW for the HVDC transmission line could be sited.

The ROI for connected actions (described in Section 2.5) are described below:

- Wind Energy Generation ROI: Twelve Wind Development Zones (WDZs) were identified by the Applicant within approximately 40-miles of the Oklahoma Converter Station Siting Area and within parts of the Oklahoma Panhandle and Texas Panhandle These WDZs exhibit adequate wind resource and are areas within which future development of wind energy facilities could occur. Wind energy generation would likely occur within WDZs. The ROI for the 12 WDZs is approximately 1,385,000 acres in Oklahoma (Beaver, Cimarron, and Texas counties) and Texas (Hansford, Ochiltree, and Sherman counties).
- Optima Substation ROI: The future SPS Optima Substation would be constructed within approximately 160 acres of land and would be located within a few miles of the Oklahoma converter station in Texas County, Oklahoma. It would be partially located within the Oklahoma AC Interconnection Siting Area and shown on Figure 2.1-3 (located in Appendix A).
- TVA Upgrade ROI: TVA's Interconnection SIS has identified the following as necessary to accommodate the Plains & Eastern Clean Line HVDC interconnection: (a) upgrades to existing infrastructure and (b) construction of a new 500 kV transmission line, approximately 37 miles long, in western Tennessee, including necessary modifications to existing substations on the terminal ends of the new line. Upgrades to existing infrastructure would include; upgrading terminal equipment at three existing 500kV substations and three existing 161kV substations; making appropriate upgrades to increase heights on sixteen existing 161kV transmission lines to increase line ratings, and replacing the conductors on eight existing 161kV transmission lines (as described in Section 2.5.2). At this stage in the planning process a precise ROI has not been identified for the TVA upgrades.

These ROIs reflect the areas of analysis for direct and indirect impacts. The ROIs defined above are the "base" or standard ROI for the analysis. These ROIs have been expanded or modified on a resource specific basis where appropriate as described in certain resource area sections below. Resources where the ROIs have been expanded or modified include Air Quality and Climate Change, Environmental Justice, Groundwater, Surface Water, Special Status Wildlife and Fish Species, Socioeconomics, Transportation, and Visual Resources. For example, the ROI for examination of socioeconomic impacts (Section 3.13) of the Project was expanded to encompass counties surrounding the Project components so that impacts on economic conditions, agriculture, housing, and community services could be evaluated.

Representative ROW within the ROI

The analyses of impacts for the HVDC Applicant Proposed Route, AC collection system, and HVDC alternative routes are based on a representative 200-foot wide ROW (100 feet on either side of a representative centerline).

Quantitative data regarding the resources that would be directly intersected by the representative 200-foot-wide ROW are used as a representative example of potential impacts from a ROW that could be sited within the given ROI. The resources that could be affected by the Project vary throughout the 1,000-foot corridor where the actual ROW could be located. The representative ROW does not necessarily reflect where particular resources are most or least concentrated, or an average. For example, the representative ROW avoids many homes and environmental resources, and so moving the ROW within the 1,000-foot corridor could result in environmental impacts different from those described for the representative ROW.

The siting of a transmission line ROW and the converter stations would require detailed engineering that considers existing conditions; compliance with federal, state, and local permits and authorizations; and incorporation of all environmental protection measures (EPMs) adopted by the Applicant. The potential impacts presented in this EIS would serve as one source informing the siting of the HVDC and AC transmission line ROWs and converter stations. Further, the siting of the four to six ROWs for the AC transmission lines that would be part of the AC collection system would also depend on the final locations of the wind generation projects. Those locations would not be known until after completion of this EIS process (including issuance of the ROD) and closer to the time of construction of the Project.

3.1.2 Environmental Protection Measures, Best Management Practices, and Project Plans

For the purpose of all analyses for the EIS, it is assumed that the Applicant would conduct each phase of the Project in compliance with applicable federal, state and local laws, regulations and permits related to construction, operation and decommissioning of the Project. Appendix C presents an overview of potential federal and state permits and consultation that could be required for construction of the Project. Local permits and approvals would also be required for the Project.

The Project evaluated in this EIS and described in detail in Chapter 2 incorporates EPMs developed (and that would be implemented) by the Applicant to avoid or minimize potential adverse effects resulting from construction, operations and maintenance, and decommissioning of the Project. The EPMs, listed in Appendix F, are part of the Project. Applicable EPMs are referenced in each resource section and are repeated exactly as they are stated in Appendix F. Implementation of the EPMs is assumed throughout the impact analysis for this EIS.

In some resource sections, DOE has included BMPs that could further avoid or minimize potential adverse impacts. For these resource areas, implementation of the EPMs would not be adequate to avoid or minimize all potential adverse effects resulting from construction, operations and maintenance, and decommissioning of the Project.

Environmental-related project plans are also listed in Appendix F. These plans would be developed and implemented by Clean Line to avoid or minimize effects to environmental resources from construction, operations and maintenance, and/or decommissioning, as appropriate. These plans include: Transportation and Traffic Management Plan; Blasting Plan; Restoration Plan; SPCCP); SWPPP; Transmission Vegetation Management Plan (TVMP); Avian Protection Plan; a Construction Security Plan; and various cultural management planning documents. In addition, Clean Line has developed elements of a communications program, elements of which could be implemented as appropriate during the construction and/or operations and maintenance phases of the Project. The initial elements of a communications program include:

- Clean Line will review and respond to all concerns and complaints from the public.
- Clean Line will publish methods for public input through various forms of media including newspaper advertisements, online social media, email or direct correspondence.
- Clean Line will establish a toll-free hotline, mailing address, email address, and an online comment submission form to receive direct input.

Should DOE decide to participate in the Project, the EPMs would be included in the ROD as part of the project and also by one or more participation agreements. In addition, the ROD or other binding federal document may include conditions of approval (e.g., BMPs) imposed by DOE or other agencies that has a decision to make or a consultation responsibility (e.g., TVA, USACE, USFWS) regarding the Project. The participation agreement(s) between the Applicant and DOE would require a monitoring plan to ensure implementation of some or all such conditions of approval.

3.1.3 Impact Analyses

Impacts to each resource are discussed in terms of direct, indirect, temporary, short-term, long-term, and permanent impacts in the sections that follow. Direct impacts occur at the same time and place as the Project. Indirect impacts are effects that may occur later in time, or further away from the Project, but are still reasonably foreseeable. Impacts are also characterized by time frame: temporary, short-term, long-term, or permanent. Temporary impacts would occur during construction, with the resource returning to preconstruction conditions once construction is complete. Short-term impacts would continue beyond the completion of construction and last from 2 to 5 years, depending on the resource affected. Long-term impacts would last beyond 5 years and could extend for the life of the Project; these impacts pertain to resources requiring longer recovery periods to return to preconstruction conditions. Permanent impacts are those that would be expected to continue even after decommissioning of the Project.

3.1.4 Chapter 3 Roadmap

3.1.4.1 Organization

Each of the following sections in this chapter is organized alphabetically by the resource sections as listed in Table 3.1-1.

Table 3.1-1:
Chapter 3 Organization

Section Number	Resource
3.2	Agricultural Resources
3.3	Air Quality and Climate Change
3.4	Electrical Environment
3.5	Environmental Justice
3.6	Geology, Paleontology, Minerals, and Soils
3.7	Groundwater
3.8	Health, Safety, and Intentional Destructive Acts
3.9	Historical and Cultural Resources
3.10	Land Use
3.11	Noise
3.12	Recreation

Table 3.1-1:
Chapter 3 Organization

Section Number	Resource
3.13	Socioeconomics
3.14	Special Status Wildlife and Fish, Aquatic Invertebrate, and Amphibian Species
3.15	Surface Water
3.16	Transportation
3.17	Vegetation Communities and Special Status Plant Species
3.18	Visual Resources
3.19	Wetlands, Floodplains, and Riparian Areas
3.20	Wildlife, Fish, and Aquatic Invertebrates

Specific headings within each resource section include the following:

- Affected Environment
    - Regulatory background
    - Data sources
    - Region of influence
    - Affected environment by geographic region (Region 1–Region 7)
- Impacts
    - Methodology
    - Impacts associated with the Applicant Proposed Project
    - Impacts associated with the DOE Alternatives
    - Best management practices
    - Unavoidable adverse impacts
    - Irreversible and irretrievable commitment of resources
    - Relationship between local short-term uses and long-term productivity
    - Impacts from connected actions

A reference CD has been provided for the reader to ensure easy access to certain reference documents used to develop this EIS. Included on the CD are the following reference documents:

- The *Alternatives Development* Report (DOE 2013), which describes the routing process that DOE and Clean Line followed to develop the Applicant Proposed Route and the DOE Alternatives evaluated in this EIS
- Resource-specific technical reports developed by Clean Line of existing environmental conditions in the ROI
- PDF files of reference works consulted during the development of this EIS that are not available on the Internet and not protected by copyright laws

3.1.4.2 Definitions

Each section contains a discussion of unavoidable adverse impacts, irreversible and irretrievable commitment of resources, and relationship between short-term uses and long-term productivity. Unavoidable adverse impacts are caused by or resulting from the Project that are adverse and cannot be avoided with implementation of EPMs and recommended BMPs.

An “irreversible commitment of resources” occurs when, once committed to the Project, the resource would continue to be committed throughout the life of the Project but would become available again following decommissioning of the Project and restoration (if necessary). An "irretrievable commitment of resources" occurs when, once used, consumed, destroyed or degraded during construction, operation, maintenance, or decommissioning of the Project, the resource would no longer be unavailable for use by future generations. Such resources could not be restored, replaced, or otherwise retrieved for the life of the Project or thereafter. Examples of irretrievable types of resources include nonrenewable resources, such as minerals and cultural resources, as well as renewable resources that would be unavailable for the use of future generations such as loss of habitat that is not restored following or as part of decommissioning of the Project.

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. In this EIS, short-term impacts are those impacts expected to occur during construction. Long-term impacts are those impacts expected to last beyond 5 years and could extend for the life of the Project. Permanent impacts are those that would be expected to continue even after decommissioning of the Project.

Finally, it should be noted that there are several supporting tables that summarize characteristics associated with the affected environment and environmental impacts. Values presented in the supporting tables to this chapter for acres, mileages, and percentages have been rounded to the nearest 0.1, and values between 0 and less than 0.1 were typically rounded to 0 and 0.1, respectively. Because the numbers have been rounded, summation of the values in the table may not always be exact.

Contents

Figures Presented in Appendix A

Tables

3.2 Agricultural Resources

3.2.1 Regulatory Background

Land use laws, regulations, and standards relevant to agricultural resources in the ROI are summarized in Table 3.2-1.

Table 3.2-1:
Land Use Laws, Regulations, and Standards Relevant to Agricultural Resources

Statute/Regulation	Agency	Applicability to the Project
Federal		
U.S. Department of Agriculture (USDA) Conservation Program	USDA	The USDA is authorized to provide monetary and technical support to private landowners who reserve agricultural lands for protection of wildlife, wildlife habitat, and wetlands. Contracts are made with landowners to set aside acreage for the reserve programs. These programs include the Conservation Reserve Program (CRP), administered by the Farm Service Agency (FSA), and the Grassland Reserve Program (GRP) and the Wetlands Reserve Program (WRP), both administered by the NRCS. The CRP is administered by the FSA, with the NRCS providing technical land eligibility determinations, conservation planning, and practice implementation. The FSA does not distribute the location of CRP lands without written authorization from landowners, although the number of acres enrolled in CRP in 2007 is available and presented in Tables 3.2-2 through 3.2-9.
Farmland Protection Policy Act	USDA Natural Resources Conservation Service	See Section 3.6 for further information regarding the Farmland Protection Policy Act (FPPA).

3.2.2 Data Sources

Information on cultivated crops was obtained from the USDA National Agricultural Statistics Service CropScape Map (GIS Data Source: NASS 2013). Flood control project dam locations were identified only within Oklahoma and were provided by NRCS (GIS Data Source: NRCS 2005).Section 3.10.2 provides further detail for the land cover and structure data sources that were used.

3.2.3 Region of Influence

For agricultural resources, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.2.4 Affected Environment

The affected environment includes the agricultural practices for the ROI in Regions 1 through 7 as described below. Section 3.6 provides further discussion on the designation of prime or unique farmland and farmland of statewide importance, and Section 3.10 provides the percentage and acreage of cultivated crops for each region.

Agriculture is the predominant land use in the ROI in Regions 1 through 7. In Regions 1, 2, and 3, grassland/pasture is the primary type of agriculture. In Regions 4 and 5, pasture/hay is the primary type of agriculture, whereas cultivated crops are more prevalent in Regions 6 and 7 (Figure 3.2-1 located in Appendix A). Agricultural structures found in the ROI in Regions 1 through 7 include concentrated animal feeding operations, barns, and silos, which are distributed throughout the ROI in each region. Center-pivot, mechanically irrigated, and precision-graded fields are also found in the ROI in Regions 1 through 7. Additionally, USDA-constructed dams are located within the ROI of Regions 3 and 4 (GIS Data Source: NRCS 2005). These dams were constructed primarily for flood control.

The market values for agriculture, crops, and livestock are provided in further detail in Section 3.13. Additionally, Section 3.13 provides information on agriculture for the counties that are within the ROI, based on data from the Agricultural Census (USDA 2009a).

3.2.5 Regional Description

3.2.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D, as well as the Oklahoma converter station, AC interconnection, and AC collection system routes. The ROI in Region 1 traverses through five counties in Oklahoma, Beaver, Cimarron, Harper, Texas, and Woodward. The majority land use is agriculture, which includes center-pivot irrigation and pasture/hay and is interspersed with well fields. Winter wheat is the primary crop (GIS Data Source: NASS 2013). Major cultivated crops represented within the AC collection system routes, which include winter wheat, pasture/hay, corn, sorghum, cotton, and alfalfa, are shown in Figure 3.2-1a in Appendix A. Table 3.2-2 summarizes the agricultural land use profiles for the ROI in Region 1, including the number of acres enrolled in the CRP in 2007 (FSA 2014). Agriculture is one of the major industries in the region; the market values for agriculture, crops, and livestock are provided below.

Table 3.2-2:
ROI Profile of Agriculture—Region 1

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Texas	Oklahoma	92%	0	$779,868,000	$114,748,000	$665,120,000
Beaver	Oklahoma	97%	0	$188,463,000	$36,217,000	$152,246,000
Cimarron	Oklahoma	89%	0	$261,870,000	$46,957,000	$214,913,000
Harper	Oklahoma	93%	1,074	$122,741,000	$10,483,000	$112,258,000
Hansford	Texas	99%	525	$589,799,000	$86,705,000	$503,094,000
Ochiltree	Texas	99%	3,709	$395,063,000	—[1]	—[1]
Sherman	Texas	99%	2,083	$448,860,000	$104,162,000	$344,697,000

1 Withheld to avoid disclosing data for individual farms.
Source: USDA (2009b, 2009c, 2009d, 2009e)

Within the ROI for the Applicant Proposed Route and the HVDC alternative routes, there are 105 agricultural structures. Within the ROI for the Oklahoma Converter Station Siting Area and the representative Oklahoma AC interconnection, there are no agricultural structures. Within the 13 AC collection system routes are 1,528 agricultural structures.

3.2.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B. The ROI in Region 2 traverses Woodward, Major, and Garfield counties in Oklahoma. The majority land use is rangeland and cultivated crops and includes some regions considered to be the wheat belt of Oklahoma. Major cultivated crops represented in the area, such as alfalfa, winter wheat, sorghum, corn, and canola are grown in the ROI in this region (GIS Data Source: NASS 2013) and are shown in Figure 3.2-1b in Appendix A. Table 3.2-3 summarizes the agricultural land use profiles for the ROI in Region 2, including the number of acres enrolled in the CRP in 2007 (FSA 2014).

Table 3.2-3:
ROI Profile of Agriculture—Region 2

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Woodward	Oklahoma	98%	700	$78,676,000	—[1]	—[1]
Major	Oklahoma	85%	2,300	$113,007,000	$12,644,000	$100,363,000
Garfield	Oklahoma	98%	1,593	$76,195,000	$29,268,000	$46,927,000

1 Withheld to avoid disclosing data for individual farms.
Source: USDA (2009c)

3.2.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. The ROI in Region 3 traverses Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma. The majority land use is rangeland and cultivated crops and includes areas considered to be the wheat belt of Oklahoma. Major cultivated crops represented in the area, such as alfalfa, winter wheat, sorghum, rye, and canola are grown in the ROI in this region as shown in Figure 3.2-1c in Appendix A (GIS Data Source: NASS 2013). Table 3.2-4 summarizes the agricultural land use profiles for the ROI in Region 3, including the number of acres enrolled in the CRP in 2007 (FSA 2014).

Table 3.2-4:
ROI Profile of Agriculture—Region 3

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Kingfisher	Oklahoma	99%	0	$116,575,000	$25,255,000	$91,320,000
Logan	Oklahoma	85%	303	$48,793,000	$8,888,000	$39,905,000
Payne	Oklahoma	81%	0	$38,580,000	$5,123,000	$33,457,000
Lincoln	Oklahoma	80%	0	$37,817,000	$3,930,000	$33,888,000
Creek	Oklahoma	62%	0	$19,575,000	$3,379,000	$16,196,000
Okmulgee	Oklahoma	66%	0	$21,222,000	$3,842,000	$17,380,000
Muskogee	Oklahoma	72%	0	$52,689,000	$14,439,000	$38,250,000

Source: USDA (2009c), FSA (2014)

3.2.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. The ROI in Region 4 traverses Muskogee and Sequoyah counties in Oklahoma and Crawford, Franklin, Johnson, and Pope counties in Arkansas. The majority of land uses is pasture/hay. Major cultivated crops represented in the area, such as winter wheat, soybeans, rice, corn, and sorghum are grown in the ROI in this region and are shown in Figure 3.2-1d in Appendix A (GIS Data Source: NASS 2013). Table 3.2-5 summarizes the agricultural land use profiles for the ROI in Region 4.

Table 3.2-5:
ROI Profile of Agriculture—Region 4

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Sequoyah	Oklahoma	54%	0	$59,218,000	$5,524,000	$53,694,000
Crawford	Arkansas	31%	0	$58,523,000	$10,801,000	$47,722,000
Franklin	Arkansas	39%	0	$112,189,000	$3,238,000	$108,952,000
Johnson	Arkansas	25%	0	$134,668,000	$3,648,000	$131,020,000

Source: USDA (2009b, 2009c), FSA 2014

Within the ROI for the HVDC Applicant Proposed Route, the Lee Creek Variation, and the HVDC alternative routes, there are 337 agricultural structures. Table 3.10-8 in Section 3.10 provides agricultural land cover within the Lee Creek Variation in the Region 4 ROI, including the number of acres enrolled in the CRP in 2007 (FSA 2014). The Lee Creek Variation contains 5.8 percent grasslands/herbaceous land.

3.2.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. The ROI in Region 5 traverses Pope, Conway, Van Buren, Cleburne, White, and Jackson counties in Arkansas. The majority land uses include pasture/hay and cultivated crops. Approximately 4.5 percent of the ROI in Region 5 consists of cultivated crops. Section 3.10 presents detailed information on the land cover for the Project. Major cultivated crops represented in the area, such as winter wheat, soybeans, rice, and corn are grown in the ROI in this region and are shown in Figure 3.2-1e in Appendix A (GIS Data Source: NASS 2013). Table 3.2-6 summarizes the agricultural land use profiles for the ROI in Region 5. Within the ROI for the Applicant Proposed Route, the HVDC alternative routes, the Arkansas Converter Station Siting Area, and the AC Interconnection Siting Area are 253 agricultural structures.

Table 3.2-6:
ROI Profile of Agriculture—Region 5

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Pope	Arkansas	30%	0	$148,863,000	$142,758,000	$148,863,000
Conway	Arkansas	53%	192	$133,581,000	$10,926,000	$122,655,000
Van Buren	Arkansas	25%	0	$15,502,000	$14,226,000	$15,502,000
Cleburne	Arkansas	37%	0	$56,122,000	$1,618,000	$54,505,000
Faulkner	Arkansas	46%	0	$19,856,000	$5,830,000	$14,026,000
White	Arkansas	62%	2,857	$119,240,000	$84,999,000	$119,240,000
Jackson	Arkansas	74%	2,366	$106,853,000	$102,272,000	$4,582,000

Source: USDA (2009b), FSA (2014)

3.2.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. The majority of the land (from 70 to 80 percent of the land area) in the counties crossed by the ROI for Region 6 (Cross, and Poinsett Counties in Arkansas) is used for agriculture. See

Table 3.13-9 and Table 3.2-7 for further information. The majority of the agricultural land in theses counties is irrigated cropland. Groundwater is the source for most irrigation water used in these counties. Common irrigation systems in these areas include furrow and flood systems, with overhead sprinkler (center-pivot) irrigation also present, but to a lesser extent (see Appendix H). Major cultivated crops represented in the area, such as winter wheat, soybeans, rice, and corn are grown in the ROI in this region and are shown in Figure 3.2-1f in Appendix A (GIS Data Source: NASS 2013). As discussed in Section 3.13, rice grown in Arkansas is 100 percent irrigated. Corn requires timely irrigation to maximize its yield potential and is almost entirely irrigated in the region. The majority of cotton and soybean acres are also irrigated in the three counties crossed by the ROI in Region 6 (see Appendix H). Table 3.2-7 summarizes the agricultural land use profiles for the ROI in Region 6, including the number of acres enrolled in the CRP in 2007 (FSA 2014). Within the ROI for the Applicant Proposed Route and the HVDC alternative routes are 30 agricultural structures.

Table 3.2-7:
ROI Profile of Agriculture—Region 6

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Cross	Arkansas	72%	733	$111,644,000	$110,773,000	$870,000
Poinsett	Arkansas	70%	242	$154,160,000	$153,325,000	$835,000

Source: USDA (2009b), FSA (2014)

3.2.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. The ROI in Region 7 traverses Poinsett and Mississippi counties in Arkansas and Tipton and Shelby counties in Tennessee. The irrigated agriculture overview presented above for Jackson, Cross, and Poinsett counties in Region 6 also apply to the Arkansas counties crossed by the ROI for Region 7. Major cultivated crops represented in the area, such as corn, soybeans, winter wheat, and cotton are grown in the ROI in this region and are shown in Figure 3.2-1f in Appendix A (GIS Data Source: NASS 2013). Extensive cultivated crops have replaced the historical wetlands. Table 3.2-8 summarizes the agricultural land use profiles for the ROI in Region 6, including the number of acres enrolled in CRP in 2007 (FSA 2014). Within the ROI for the Applicant Proposed Route, the HVDC alternative routes, and the Tennessee Converter Station Siting Area are 50 agricultural structures.

Table 3.2-8:
ROI Profile of Agriculture—Region 7

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Mississippi	Arkansas	80%	192	$195,596,000	$194,984,000	$612,000
Shelby	Tennessee	19%	0	$23,539,000	$21,036,000	$2,503,000
Tipton	Tennessee	58%	228	$37,027,000	$34,344,000	$2,683,000

Source: USDA (2009d, 2009e), FSA (2014).

Note: The respective route alternatives do not go through the same counties as listed in the table above.

3.2.5.8 Connected Actions

3.2.5.8.1 Wind Energy Generation

Land cover in the WDZs is primarily cultivated crops and grassland/herbaceous. The land cover in each WDZ is summarized in Section 3.10. Existing agricultural land uses in the WDZs include irrigated and dry cultivated crops and feedlots. Agricultural structures in the WDZs include barns and silos. Additionally, rural residences are scattered on large parcels of land and generally surrounded by agricultural land uses.

Table 3.2-9 summarizes the agricultural land use profiles for the WDZs. Agriculture is one of the major industries in the counties where the WDZs are located; the market values for agriculture, crops, and livestock are provided in Table 3.2-9. Section 3.13 describes socioeconomic impacts in detail.

Table 3.10-12 presents the land cover in each respective WDZ. The number of acres enrolled in CRP in 2007 is available and presented in the table below (FSA 2014).

Table 3.2-9:
ROI Profile of Agriculture—WDZ Analysis in Oklahoma and Texas

County	State	Percent of Land Area as Farm	Acres Enrolled in CRP	Market Value of Agriculture Products Sold	Market Value of Crops Sold	Market Value of Livestock and Product Sold
Beaver	Oklahoma	97%	0	$188,463,000	$36,217,000	$152,246,000
Cimarron	Oklahoma	89%	0	$261,870,000	$46,957,000	$214,913,000
Texas	Oklahoma	92%	0	$779,868,000	$114,748,000	$665,120,000
Hansford	Texas	99%	525	$589,799,000	$86,705,000	$503,094, 000
Ochiltree	Texas	99%	3,709	$395,063,000	—[1]	—[1]
Sherman	Texas	99%	2,083	$448,860,000	$104,162,000	$344,697,000

1 Withheld to avoid disclosing data for individual farms
Source: USDA (2009c, 2009e), FSA (2014)

3.2.5.8.1.1 WDZ-A

The predominant land cover in WDZ-A is approximately up to 60.3 percent cultivated crops. Additionally, the agricultural land cover is up to 26.1 percent grassland/herbaceous and 0 percent pasture/hay.

3.2.5.8.1.2 WDZ-B

The predominant land cover in WDZ-B is up to 53.2 percent cultivated crops. Additionally, the agricultural land cover is 37.8 percent grassland/herbaceous and 0 percent pasture/hay. Central-pivot irrigation is found throughout the WDZ.

3.2.5.8.1.3 WDZ-C

The predominant land cover in WDZ-C is approximately up to 52.8 percent grassland/herbaceous; the agricultural land cover is 38.8 percent cultivated crops and 0 percent is pasture/hay.

Center-pivot irrigation is found throughout the WDZ and a concentrated animal feeding operation is located in the western portion of the WDZ southeast of Stratford, Texas.

3.2.5.8.1.4 WDZ-D

The predominant land cover in WDZ-D is up to 69.3 percent grass and/herbaceous; the agricultural land cover is up to 17.8 percent cultivated crops and 0 percent is pasture/hay. Transmission lines and center-pivot irrigation are present in the northern and southern portions of the WDZ.

3.2.5.8.1.5 WDZ-E

The predominant land cover in WDZ-E is approximately 57.0 percent cultivated crops; the agricultural land cover is up to 31.9 percent grassland/herbaceous and 0 percent is pasture/hay.

3.2.5.8.1.6 WDZ-F

The predominant land cover in WDZ-F is up to 67.0 percent grassland/herbaceous; the agricultural land cover is up to 25.4 percent cultivated crops and 0 percent is pasture/hay. Center-pivot irrigation is found throughout the WDZ.

3.2.5.8.1.7 WDZ-G

The predominant land cover in WDZ-G is up to 53.0 percent grassland/herbaceous; the agricultural land cover is up to 40.5 percent cultivated crops and 0 percent is pasture/hay. A few parcels with central-pivot irrigation are located in the northern portion of the WDZ.

3.2.5.8.1.8 WDZ-H

The predominant land cover in WDZ-H is up to 81.5 percent grassland/herbaceous; the agricultural land cover is 12.9 percent cultivated crops and 0 percent is pasture/hay. A few parcels have center-pivot irrigation.

3.2.5.8.1.9 WDZ-I

The predominant land cover in WDZ-I is up to 61.1 percent cultivated crops; the agricultural land cover is up to 23.8 percent is grassland/herbaceous and 0 percent is pasture/hay.

Center-pivot irrigation is found primarily in the central portion of the WDZ. Concentrated animal feeding operations are also found in the WDZ.

3.2.5.8.1.10 WDZ-J

The predominant land cover in WDZ-J is up to 73.6 percent grassland/herbaceous; the agricultural land cover is up to 12.9 percent cultivated crops and 0 percent is pasture/hay.

Some central-pivot irrigation structures are present in the central portion of the WDZ.

3.2.5.8.1.11 WDZ-K

The agricultural land cover in WDZ-K is up to 46.5 percent cultivated crops; the agricultural land cover is up to 42.2 percent grassland/herbaceous and 0 percent is pasture/hay. Existing infrastructure includes transmission lines and some scattered center-pivot irrigation.

3.2.5.8.1.12 WDZ-L

The predominant land cover in WDZ-L is up to 55.2 percent cultivated crops; the agricultural land cover is up to 28.4 percent grassland/herbaceous and 0 percent is pasture/hay. Center-pivot irrigation is found throughout the WDZ.

3.2.5.8.2 Optima Substation

The land cover in the future Optima substation location is primarily grassland/herbaceous. There are no structures or existing infrastructure on the 160-acre site, although there are roads and an operating wind farm nearby. Cultivated crops are located south of the Optima substation, while grassland/herbaceous is the predominant agricultural land cover that surrounds the Optima substation.

3.2.5.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed qualitatively as described below.

3.2.6 Impacts to Agricultural Resources

The majority of the land crossed by the Project is used for agriculture, including grassland/herbaceous, cultivated crops, and pasture/hay. The analysis includes the potential for direct impacts to agricultural land from construction of the Project as well as on agricultural structures such as barns or storage silos. Potential indirect impacts to agricultural production to adjacent land and from impacts to aerial applications of fertilizer, insecticide, and herbicide and socioeconomic impacts to farmers and ranchers as a result of the impacts to the agricultural land are also discussed.

Section 3.10 provides a discussion of the existing roads, existing transmission lines, and existing infrastructure that parallel each route for the Applicant Proposed Project and the HVDC Applicant Proposed Route. Impacts to agricultural structures are discussed in Sections 3.2.6.2 and 3.2.6.3.

3.2.6.1 Methodology

To identify potential impacts to agriculture that may result from construction and operations and maintenance of the Project, the analysis of the HVDC transmission line route alternatives, the Oklahoma and Arkansas AC interconnection lines, the Tennessee, Oklahoma, and Arkansas converter stations, and the high voltage AC collection line in Oklahoma was based on a desktop review of existing land uses within a representative centerline developed for each route alternative, data from the National Land Cover Dataset, and several online research sites that are listed in Section 6.5. A 200-foot-wide representative ROW (100 feet on each side) centered on the representative centerline was developed. Section 3.10.6 presents a more detailed discussion of the specific footprint that would be affected during each phase of the Project. In the impacts discussion, the number and type of structures within the ROW are listed, although it is assumed that the displacement of structures would be avoided in the final engineering and design of the Project.

The NRCS has informed the DOE that in Oklahoma, a Corridor Assessment Rating or LESA, as described in Table 3.1-1, is not required to be completed on form CPA-106 for the HVDC. A LESA could not be in part because of the lack of prime farmland located in the representative ROW. Therefore, at this time a LESA has not been completed. Applicant Proposed Route, HVDC transmission line route alternatives, the Oklahoma interconnection line, or the AC collection system alternatives because farmland will not be permanently and directly converted to another use. The transmission line will be constructed aboveground with little or no disturbance at ground level (Adams 2014).

The Applicant has developed a comprehensive list of EPMs to be integrated into the Project. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. Section 3.1 describes the EPMs in more detail. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that are applicable to agricultural resources are listed below:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations.
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.
- AG-1: Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems.
- AG-2: Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments.

- AG-3: Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands.
- AG-4: Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms.
- AG-5: Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., aerial crop spraying) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. Clean Line will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure.
- AG-6: Clean Line will work with landowners to develop compensation for lost crop value caused by construction and/or maintenance.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.

3.2.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Project that would be common to the converter stations, AC interconnection, AC collection system routes, and Applicant Proposed Routes that are all part of the Applicant Proposed Project. Impacts from the construction, operations and maintenance, and decommissioning of the Applicant Proposed Project are discussed separately by Project component.

General Agriculture

Temporary impacts on agriculture productivity during construction could potentially occur as a result of vegetation, and soil disturbance or loss. Impacts to pasture and cultivated crops in the construction area would be temporary and would include the temporary loss of vegetation and soils. Additionally, vegetation would be lost when grading is required and along travel routes, or roads that construction equipment travel on to a construction destination, for construction vehicles and equipment. Additional impacts to soils are provided in Section 3.6.2. Figure 3.2-1a–f in Appendix A depicts agricultural lands that are located within the ROI and ROW.

Direct impacts to agricultural structures, such as barns, ponds, silos, and animal feeding operations, within the representative ROW would be minimal. The number of agricultural structures for each alternative is presented in Section 3.2.6.2.2.1. The Project could limit future expansion of existing structures in the long term since construction of new structures would be prohibited within the Project representative ROW. Potential impacts would occur in Regions 1 through 7.

Impacts to agriculture during operations and maintenance of the Project are expected to be minimal in most areas because the majority of the representative ROW could be used for grazing and cultivated crops, if it is already being used as agricultural land, once construction has been completed. Section 3.2.6.2 discusses the operation and maintenance impacts to agriculture. Maintenance of the Project facilities may occasionally disrupt agricultural activities and production on a localized basis. In addition, the transmission structures may interfere with farming equipment and the transmission lines and poles may interfere with aerial spraying of herbicides, pesticides, fungicides, and fertilizer.

Impacts to specific categories of agriculture are discussed below.

Livestock Grazing

Construction could affect livestock grazing by temporarily reducing forage and displacing livestock in the representative ROW. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged, as livestock may not be contained and may escape. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions.

Once the Project has been constructed, livestock would be permitted to graze around Project features. Direct impacts to rangeland could include long-term loss of vegetation from structure foundations and permanent access roads. During Project operations, grazing land occupied by support structures, substations, or access roads would no longer be available for grazing. The acres of lands used for livestock and grazing that would be affected by the Project represent a small share of the total acres used for livestock area within the representative ROW and would result in relatively small temporary and long-term reductions in the area available for grazing within the representative ROW.

Crop Production

Construction would temporarily prevent or reduce crop production in the representative ROW. Potential impacts may extend outside the construction area due to access constraints, impacts to irrigation structures, and/or pesticide or fertilizer application practices. Access constraints could result in a diminished yield in and near the construction area if other methods of irrigation and fertilizer, insecticide, and herbicide application are not practical. Potential economic impacts related to cultivated crop impacts are discussed in Section 3.13.

During Project operations, the physical footprint of structures, substations, and access roads would displace cultivated crops. Tractors, combines, and other mechanized equipment would be required to maneuver around structures. Structures and conductors could limit the aerial application of fertilizer, herbicide, and pesticide and could result in a diminished harvest. Crop production that involves mechanical irrigation, automated farming methods, or farming equipment with large spans (up to 100 feet) could also be adversely affected by the placement of overhead conductors and support structures. Production costs increase where farmers have to divert their equipment around structures, make additional passes, take additional time to maneuver, reconfigure surface drainage, skip acres, or re-treat acres.

In most cases, structures can be located strategically to allow existing pivots to continue to operate without adverse effects and interruption of agricultural activity.

Center-pivot Irrigation

Potential temporary impacts to center-pivot irrigation could occur primarily in Regions 1, 2, 6, and 7. The operation of center-pivot irrigation during construction could be limited in construction areas. Construction equipment at tensioning and pulling sites and structure work areas could prevent the movement of irrigation systems if construction occurs during the growing season, which would prevent portions of the field from being irrigated.

Project operation, schedule maintenance, and unscheduled repairs due to storm damage have the potential to damage crops and agricultural water management systems such as center-pivot irrigation. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1). Additionally, Project inspections could be performed outside areas of the fields. The Applicant would work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6).

The representative 200-foot ROW for the Applicant Proposed Route or HVDC alternative routes would cross agricultural fields that are irrigated by center pivots. Agricultural operations in these areas could be limited in the long term depending on the location of the transmission structures. Project components could prevent portions of fields from being irrigated by blocking the movement of the irrigation system. Direct impacts could potentially occur in Regions 1, 2, 6, and 7. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1). The resulting dryland area could be measured and the affected parties could be compensated for the decreased productivity that results (see Appendix H).

Flood Irrigation

During construction, access roads, temporary work areas, and other graded areas could temporarily disrupt the slope and flow patterns of water on flood-irrigated fields, such as rice fields in eastern Arkansas. This impact would vary depending on the location of the Project and whether it is located upslope or downslope. Soils within the representative ROW and construction area would be temporarily compacted. Construction activities could temporarily limit access to flood-irrigated fields or impair normal agricultural operations. These direct impacts could result in a diminished yield and, dependent on the timing of construction, a loss of rice-growing opportunity inside and/or outside of the representative ROW.

During operations and maintenance, the Applicant would allow agricultural activities to resume within the ROW. During operations of the Project, transmission structures and surrounding graded areas and regions that have flood-irrigated or precision-graded fields could disrupt the flow of water on flood-irrigated fields or precision-graded fields in the long term. This disruption could have a long-term impact by diminishing crop production in localized areas downhill from the water source.

Global Navigation Satellite Systems

Farming equipment often use Global Navigation Satellite Systems (GNSS) for automated steering, custom geographic seeding and fertilizing and harvest yield mapping. Regarding the issue of GNSS interference from overhead high voltage transmission lines, research performed on the impacts did not reveal a problem for the high-quality receivers used in precision agriculture or agriculture-related aviation. No effect due to transmission line on GNSS measurements was found to impact the quality of the GNSS (Bancroft et al. 2012).

Aerial Crop Spraying

Aerial crop spraying is common in the region where there is agricultural land. Aerial crop spraying is used to apply fertilizer, fungicides, or pesticides during the growing season. Aerial crop spraying is supported by a network of controlled airports and secondary airstrips. Aerial crop spraying can involve dry applications (usually fertilizer) and liquid applications of fungicides and pesticides. The typical aircraft used for aerial application is a fixed single-wing plane, which are typically equipped with digital global positioning systems or other guidance systems. Typically, liquid applications are applied from 8 feet to 12 feet above the target; while dry applications are applied from 45 feet to 70 feet above targeted land (see Appendix H).

The adjacent swath is the most common flight pattern used in crop fields, which involves the use of straight, parallel swaths to apply products in a back and forth pattern. Applicators are accustomed to turning their spray on and off to avoid overlapping or missing spots; they are also accustomed to maneuvering around obstacles in fields (see Appendix H).

Spraying operations occur 24 hours a day, depending on the time of season; nighttime operations occur when bees are pollinating crops during daylight hours. The quantity of farmed land receiving aerial crop spraying in and near the representative ROW is not known. As a result, the following analysis assumes that any dryland or irrigated farmland could receive aerial spraying.

Construction of the transmission line could reduce the area of crops that could be treated by aerial spraying. Transmission structures or construction cranes could interfere with the flight paths of aerial applications. The potential effects would vary, depending on the location of tall structures relative to crop planting patterns, and the presence of other tall structures. Aerial spraying is also sometimes used to control large-scale insect infestations on public and private land. The short-term inability to use aerial spraying could reduce productivity and cause economic effects to farming or rangeland operations. The presence of construction workers could also delay applications.

Once construction has been completed, aerial crop spraying planes could fly at a higher altitude to avoid transmission lines and structures. A common method to maneuver around obstacles in fields is to “trim” the edge of a field by flying perpendicular to the direction the field was flown. Another approach is to stop spraying as the obstacle is approached, turn at 360 degrees, fly over the obstacle, then drop back down and continue spraying. Applicators can fly beneath the lines or wires in cases where transmission lines and other wires are positioned high enough. It may be possible to spray over the top of the obstruction in situations where the transmission lines or wires are low (see Appendix H).

However, this could result in a less precise application of fertilizer, herbicide, and pesticide, and these treatments could spill into adjacent fields. Additionally, impacts associated with aerial application could extend beyond the representative ROW as a result of the need to fly over transmission lines. Although the Applicant has made efforts to site the transmission lines adjacent to existing infrastructure, impacts may still occur in these areas due to structure heights that are taller than existing structure heights and a wider area that aerial applications must avoid.

Herbicide spraying for weed control along the transmission line representative ROW could affect organic farmers if fields of organic crops are sprayed inadvertently.

EPMs that would avoid the impacts to agriculture are discussed in Section 3.2.6.1.

3.2.6.2.1 Converter Stations and AC Interconnection Siting Areas

This section describes the impacts to agriculture from the converter stations on either end of the HVDC transmission line and their associated AC interconnection lines. Impacts from the construction, operations and maintenance, and decommissioning of the various Project components are discussed separately under each subsection. Section 3.13 provides additional information on the socioeconomic agricultural impacts.

3.2.6.2.1.1 Construction Impacts

Direct agricultural impacts during construction would consist of long-term conversion of land for the converter station and temporary conversion of land within the representative ROW for the AC interconnection line. Potential impacts to agriculture from the construction of the Oklahoma and Tennessee converter stations and their associated AC interconnection lines are discussed below.

3.2.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma converter station would be located on undeveloped rangeland; approximately 94.8 percent of the land cover in the siting area is grassland/herbaceous. Construction of the converter station would convert 45 to 60 acres of rangeland to an industrial land use. During construction, an additional 5 to 10 acres would be used as temporary laydown areas for equipment. An additional 4.24 acres of rangeland would be converted to access roads (2.42 acres long term, 1.82 acres temporary).

The Oklahoma AC interconnection would be approximately 2.7 miles long. The agricultural land cover in the representative ROW is currently composed of 58 acres of grasslands. Work in the representative ROW would include assembly of pole structures, wire splicing, and tensioning and pulling. Outside the representative ROW, two additional tensioning and pulling sites of (2.58 acres each, for a total of 5.16 acres) and approximately 25 acres of multi-use construction yards would be required.

During construction, assembly areas for the pole structures (either lattice or tubular structures) would be required, as would wire splicing sites and tensioning and pulling sites. Within the 65.5 acre ROW, an assembly area of 150 feet wide by 150 feet long for each structure would be required. Assuming five to seven structures per mile would be required, the assembly areas would take up between 7.7 and 10.8 acres within the ROW. Approximately two wire splicing sites, each 100 feet by 100 feet (0.2 acre) would be used within the ROW during construction.

Two additional tensioning and pulling sites, 150 feet wide by 750 feet long, also would be required within the ROW (2.6 acres each, for a total of 5.2 acres) and approximately 25 acres of multi-use construction yards would be required. Temporary work areas that would be required outside the representative ROW include fiber optic regeneration sites, multi-use construction yards, and fly yards.

Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8).

3.2.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

The land cover in the Tennessee Converter Station Siting Area is approximately 80.1 percent agricultural land cover (53.6 percent cultivated crops and 26.5 percent pasture/hay). No center-pivot irrigation or other irrigation infrastructure is known to occur. Although the exact location has not yet been determined, construction of this converter station would convert 45 to 60 acres of currently undeveloped land to an industrial land use. During construction, an additional 5 to 10 acres used as temporary laydown areas for equipment. An additional 4.24 acres of rangeland would be converted to access roads (2.42 acres long term, 1.82 acres temporary).

The Tennessee AC interconnection would be located entirely within the Tennessee Converter Station Siting Area and would be approximately 0.20 mile long. During construction, work in the representative ROW would convert approximately 5 acres of primarily cultivated crops and pasture/hay to an industrial use. Work in the representative ROW would include assembly of pole structures, wire splicing, and tensioning and pulling. Outside the representative ROW, two additional tensioning and pulling sites (2.58 acres each, for a total of 5.16 acres) and approximately 25 acres of multi-use construction yards would be required.

Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8).

3.2.6.2.1.2 Operations and Maintenance Impacts

Maintenance of the AC interconnection lines would be similar to construction impacts, except maintenance would require shorter work duration and would be at a smaller scale. Maintenance would likely occur on an annual basis and as needed.

3.2.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnection pole structures, and a 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced.

Within the AC interconnection ROW (200 feet wide), only the pole structures would remain with a total footprint of up to less than 1 acre. All other land in the ROW could be returned to previous land uses, primarily grazing. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations would be retained (GE-7). Land uses that would not be permitted in the ROW include constructing buildings or structures or changing the grading and land contours; some restrictions and coordination for infrastructure such as fences and irrigation lines would be required. Access may be restricted during the performance of maintenance activities.

3.2.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

Once construction has been completed, only the 45- to 60-acre converter station, the AC interconnection pole structures, and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. Approximately 45 acres would be fenced.

Within the AC interconnection siting area ROW (200 feet wide), only the pole structures would remain with a total footprint of less than 0.02 acre. All other land in the ROW could be returned to previous land uses, primarily cultivated crops and pasture/hay. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations would be retained (GE-7). Land uses that would not be permitted in the ROW include constructing buildings or structures or changing the grading and land contours; some restrictions and coordination for infrastructure such as fences and irrigation lines would be required. Access would be restricted during the performance of maintenance activities.

3.2.6.2.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Upon completion of decommissioning, all land could be returned to preconstruction land uses described in Section 3.2.5.

3.2.6.2.2 AC Collection System

This section discusses the impacts from the AC collection system. The Applicant Proposed Project consists of 13 AC collection system routes. Of the 13 AC collection system routes, four to six AC collection transmission lines of up to 345kV would be constructed from the Oklahoma converter station to points in the Oklahoma and Texas panhandles.

3.2.6.2.2.1 Construction Impacts

Construction of the AC collection system would directly affect livestock grazing by temporarily reducing forage and displacing livestock from grassland/herbaceous and pasture. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8). The Applicant would conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line would implement measures to minimize the transfer of mud onto public roads (GE-11).

Cultivated crops would be directly affected by removal of vegetation and potential removal of agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1).

Livestock

Construction and operations and maintenance of the proposed transmission lines could affect the economic value of livestock production in the representative ROW by increasing ranchers' costs and decreasing available forage.

The Project could affect net earnings from livestock production in the following ways:

- Decreased forage from land taken out of production
- Increased management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment
- Increased management costs associated with moving livestock around project-related structures and easements

The value of grazing land that would be affected is further discussed in Section 3.13.

Potential impacts to cultivated crops would vary based on the design and location of the proposed transmission line structures and access roads relative to existing agricultural operations. Section 3.13 further discusses the value of cultivated crops that would be affected.

For each route described below, it is assumed that the entire acreage within the ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of a route at the same time.

3.2.6.2.2.1.1 Route E-1

The representative ROW is approximately 708.0 acres. Approximately 574.2 acres of grassland and 48.8 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is located within the representative ROW.

3.2.6.2.2.1.2 Route E-2

The representative ROW is approximately 974.4 acres. Approximately 572.8 acres of grassland and 298.6 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route E-2.

3.2.6.2.2.1.3 Route E-3

The representative ROW is approximately 977.5 acres. Approximately 650.3 acres of grassland and 105.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. Two agricultural structures are present in the representative ROW.

3.2.6.2.2.1.4 Route NE-1

The representative ROW would disturb approximately 729.8 acres. Approximately 291.1 acres of grassland and 247.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No structures are present in the representative ROW that would be affected by the construction of AC Collection System Route NE-1.

3.2.6.2.2.1.5 Route NE-2

The representative ROW is approximately 637.4 acres. Approximately 450.2 acres of grassland and 50.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is present in the representative ROW.

3.2.6.2.2.1.6 Route NW-1

The representative ROW is approximately 1,265.4 acres. Approximately 609.5 acres of grassland and 85.0 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is present in the representative ROW.

3.2.6.2.2.1.7 Route NW-2

The representative ROW is approximately 1,365.0 acres. Approximately 629.3 acres of grassland and 410.9 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. There are no existing agricultural structures in the representative ROW that would be affected by the construction of AC Collection System Route NW-2.

3.2.6.2.2.1.8 Route SE-1

The representative ROW is approximately 979.4 acres. Approximately 513.2 acres of grassland and 340.0 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SE-1.

3.2.6.2.2.1.9 Route SE-2

The representative ROW is approximately 325.4 acres. Approximately 169.9 acres of grassland and 130.6 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SE-2.

3.2.6.2.2.1.10 Route SE-3

The representative ROW is approximately 1,193.6 acres. Approximately 565.7 acres of grassland and 483.9 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SE-3.

3.2.6.2.2.1.11 Route SW-1

The representative ROW is approximately 325.6 acres. Approximately 312.8 acres of grassland would be disturbed; no cultivated crops or pasture/hay lands are located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SW-1.

3.2.6.2.2.1.12 Route SW-2

The representative ROW is approximately 901.4 acres. Approximately 733.0 acres of grassland and 33.6 acres of cultivated crops would be disturbed; no pasture/hay located within the representative ROW. No agricultural structures are present in the representative ROW that would be affected by the construction of AC Collection System Route SW-2.

3.2.6.2.2.1.13 Route W-1

The representative ROW is approximately 507.8 acres. Approximately 377.0 acres of grassland and 47.2 acres of cultivated crops would be disturbed; no pasture/hay is located within the representative ROW. One agricultural structure is present in the representative ROW.

3.2.6.2.2.2 Operations and Maintenance Impacts

The long-term impacts by segment are discussed below for pole structures and are summarized in Table 3.10-12. No impacts are described for access roads, because the location of access roads has not yet been determined.

Livestock

Construction and operations and maintenance of the proposed transmission lines could affect the economic value of livestock production in the ROW by increasing ranchers' costs and decreasing available forage. The Project could affect net earnings from livestock production in the following ways:

- Decrease forage from land taken out of production
- Increase management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment
- Increase management costs associated with moving livestock around Project-related structures and easements

The value of grazing land that would be affected is further discussed in Section 3.13.

Most agricultural activities such as livestock grazing and cultivating crops could be returned to the ROW upon the completion of construction. The long-term disturbance in the ROW is primarily grassland/herbaceous for all the routes except for AC Collection System Route NW-1. Approximately 75 percent of the ROW for AC Collection System Route NW-1 is grassland/herbaceous.

3.2.6.2.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.2.3 HVDC Applicant Proposed Route

This section discusses the potential impacts to agriculture of the approximate 720-mile-long transmission facility during the three phases of the Project: construction, operations and maintenance, and decommissioning. Specific EPMs developed to avoid land use impacts are described in Section 3.2.6.2.1 and are referenced in the discussion below in parentheses.

3.2.6.2.3.1 Construction Impacts

The majority of the impacts to agriculture would be temporary. Construction would prevent the uses of pasture/hay land and cultivated crops in the representative ROW. Construction of the transmission line would directly affect livestock grazing by temporarily reducing forage and displacing livestock from grassland/herbaceous and pasture. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8). The Applicant would make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and oil and gas pipelines), with the intent of reducing the impact of the ROW on private properties (LU-5).

During construction, croplands would be directly affected by removal of vegetation and agricultural structures such as irrigation systems, barns, and silos. Agricultural production may be temporarily diminished. The Applicant would work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs would take place in a timely manner, weather and landowner permitting (GE-10). The Applicant would work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6).

Impacts by region are discussed below. For each region described below, it is assumed that the entire acreage within the representative ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of the representative ROW at the same time. EPMs AG-6, GE-10, and LU-4 would help to avoid or minimize impacts in each region described below.

3.2.6.2.3.1.1 Region 1

Approximately 1,742.3 acres of grassland/herbaceous and 748.8 acres of cultivated crops would be disturbed; no pasture/hay land is located within the representative ROW. One agricultural structure is present in the representative ROW of Applicant Proposed Route Link 4.

Outside the representative ROW, tensioning and pulling areas totaling approximately 100.8 acres would be required during construction. The land cover in these areas is primarily grassland/herbaceous land cover and cultivated crops.

3.2.6.2.3.1.2 Region 2

Approximately ,1,299.9 acres of grassland/herbaceous and 788.0 acres of cultivated crops would be disturbed; no pasture/hay land is located within the representative ROW. Two agricultural structures are present in the representative ROW of Applicant Proposed Route Link 3 that may need to be removed so that the transmission line could be built. The representative ROW would be temporarily unavailable during construction at this location.

Outside the representative ROW, tensioning and pulling areas totaling approximately 99.0 acres would be required during construction. The predominant land cover types are grassland/herbaceous and cultivated crops.

3.2.6.2.3.1.3 Region 3

Approximately 1,339.5 acres of grassland/herbaceous, 941.3 acres of pasture/hay lands, and 312.6 acres of cultivated crops would be disturbed.

Two agricultural structures are present in the representative ROW of Applicant Proposed Route Links 4 and 6 (one in each link) that may need to be removed so that the transmission line could be built.

Outside the representative ROW, tensioning and pulling areas totaling approximately 378.5 acres would be required during construction. The predominant land cover in these areas is grassland/herbaceous.

3.2.6.2.3.1.4 Region 4

Approximately 1,436.1 acres of pasture/hay lands, 77.5 acres of grassland/herbaceous, and 63.9 acres of cultivated crops would be disturbed. Five agricultural structures are present in the representative ROW of Applicant Proposed Route Links 6, 7, and 9 (two in each link) that may need to be removed so that the transmission line could be built.

The Lee Creek Variation is 3.4 miles long. No portion of the route is parallel to existing infrastructure. The agricultural land cover in the 200-foot representative ROW is 5.8 percent grassland/herbaceous.

Outside the representative ROW, tensioning and pulling areas totaling approximately 482.6 acres would be required during construction. The predominant land cover in these areas is pasture/hay. These areas would be temporarily unavailable during construction. One agricultural structure is present in these areas. The tensioning and pulling areas would be temporarily unavailable during construction at this location.

3.2.6.2.3.1.5 Region 5

Approximately 773.4 acres of pasture/hay land, 149.3 acres of cultivated crops, and 78.5 acres of grassland/herbaceous would be disturbed. One agricultural structure is present in the representative ROW of Applicant Proposed Route Link 2 that may need to be removed so that the transmission line could be built.

Outside the representative ROW, tensioning and pulling areas totaling approximately 291.4 acres would be required during construction. The land cover in these areas is primarily pasture/hay and deciduous forest.

3.2.6.2.3.1.6 Region 6

Approximately 1,060.0 acres or 79.9 percent of agricultural land (1,056.5 acres of cultivated crops, 3.1 acres of pasture/hay lands, and 0.5 acre of grassland/herbaceous) would be disturbed. Five agricultural structures are present in the representative ROW of Applicant Proposed Route Links 4 and 6 (one in Link 4 and four in Link 6).

Outside the representative ROW, tensioning and pulling areas totaling approximately 115.6 acres would be required during construction. The land cover in these areas is primarily cultivated crops.

3.2.6.2.3.1.7 Region 7

Approximately 729.5 acres or 69.8 percent of agricultural land (691.8 acres of cultivated crops and 36.1 acres of pasture/hay) would be disturbed; there are 1.5 acres of grassland/herbaceous in the representative ROW. Two agricultural structures are present in the representative ROW of Applicant Proposed Route Link 5.

Outside the representative ROW, tensioning and pulling areas totaling approximately 162.4 acres would be required during construction. The land cover in these areas is primarily cultivated crops.

3.2.6.2.3.2 Operations and Maintenance Impacts

Once construction has been completed, most of the land in the ROW could be returned to previous land uses, primarily agriculture (grazing and crops). Land uses that would not be permitted in the ROW include constructing buildings or structures or changing the grading and land contours; some restrictions and coordination for infrastructure such as fences and irrigation lines would be required. Access would be restricted during the performance of maintenance activities.

Livestock grazing and cultivating crops are compatible with the operations and maintenance of the Project, although there may be occasional disturbances during maintenance, which are expected to be minimal and localized in nature. Pole structures may interfere with farming equipment and aerial crop spraying, which may reduce crop yields.

The long-term impacts by region are summarized in Table 3.10-20 for pole structures. No long-term impacts are described for access roads, because the location of access roads has not yet been determined. Because the type of pole structure that would be used has not yet been determined, the impact calculations assumed lattice structures would be used for a conservative estimate of impacts. The operational footprint would be five to seven structures per mile, each measuring 28 feet by 28 feet (less than 0.02 acre).

Operation and maintenance impacts would not irreversibly convert prime farmland to non-agricultural uses in the representative ROW.

3.2.6.2.3.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.3 Impacts Associated with the DOE Action Alternatives

3.2.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.2.6.3.1.1 Construction Impacts

The land cover in the Arkansas Converter Station Alternative Siting Area is composed of approximately 4,563.4 acres (20.9 percent) pasture/hay, approximately 701.2 acres (3.2 percent) grassland/herbaceous land, and approximately 19.6 acres (0.1 percent) cultivated crops.

The Arkansas AC interconnection would be approximately 6 miles long, and during construction, approximately 146.5 acres of currently primarily pasture/hay land cover would be temporarily converted to an industrial use.

Construction of the converter station and AC interconnection would directly affect livestock grazing by temporarily reducing forage and/or displacing livestock in up to approximately 175 acres of land. If any crop land is in the construction area, crops grown in these areas would be lost and crops in adjacent areas may have reduced yields if there are disturbances to irrigation structures or in aerial spraying. The Applicant would avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant would work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1). The Applicant would work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., aerial crop spraying) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. The Applicant would avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure (AG-5). The Applicant would conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. The Applicant would implement measures to minimize the transfer of mud onto public roads (GE-11). Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions. Access controls (e.g., cattle guards, fences, gates) would be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner (GE-8).

3.2.6.3.1.2 Operations and Maintenance Impacts

Once construction has been completed, only the 40- to 50-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 40 acres would be fenced. A 5-acre site where the alternative AC transmission line would interconnect with the existing 500kV transmission line would also remain as an industrial use. Although most of this land is not currently used for agricultural purposes, up to 20.9 percent is used as pasture/hay, 3.2 percent is grassland/herbaceous, and 0.1 percent is cultivated crops. If any of these lands are used for long-term structures, they would be removed from agricultural use until decommissioning.

Within the Arkansas AC interconnection (200 feet wide by 6 miles long), only the pole structures and most access roads would remain. Roads not otherwise needed for maintenance and operations would be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations would be retained. (GE-7). All other land in the ROW could be returned to previous land uses, except that only low-growing vegetation would be permitted in the ROW. Short trees (up to 25 feet in height at maturity) would be permitted adjacent to the representative ROW. Land uses that would not be permitted in the ROW include constructing buildings or structures or changing the grading and land contours; some restrictions and coordination for infrastructure such as fences and irrigation lines would be required. Access would be restricted during the performance of maintenance activities. Because 44.8 percent of the Arkansas AC interconnection ROW is composed of pasture/hay land, it is anticipated that most of this land could be returned to pasture/hay during operations because it is a compatible use. Maintenance activities would have minimal impacts on the use of pasture/hay lands.

3.2.6.3.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.3.2 HVDC Alternative Routes

This section discusses the potential impacts to agriculture within the 200-foot-wide representative ROWs of the HVDC alternative routes during the construction, operations and maintenance, and decommissioning phases of the Project.

3.2.6.3.2.1 Construction Impacts

The types of construction impacts would be similar to those discussed for the Applicant Proposed Route (Section 3.2.6.2.3). The majority of the impacts to agriculture would be temporary. Construction would prevent the use of rangeland and cultivated crops in the representative ROW. Construction of the transmission line would directly affect livestock grazing by temporarily reducing forage and displacing livestock from grassland/herbaceous and pasture/hay. Temporary work areas that would be required outside the representative ROW include fiber optic regeneration sites, multi-use construction yards, and fly yards. Construction may affect livestock control and distribution if a gate is left open or a fence is damaged. Vehicular access during construction would increase the likelihood of livestock injury or death from collisions.

Cultivated crops would be directly affected by removal of vegetation and agricultural structures such as irrigation systems, barns, and silos. The Applicant would work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs would take place in a timely manner, weather and landowner permitting (GE-10). The Applicant would work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6). Agricultural production may be temporarily diminished.

Impacts by region are discussed below. For each alternative route described below, it is assumed that the entire acreage within the representative ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of the representative ROW at the same time.

3.2.6.3.2.1.1 Region 1

3.2.6.3.2.1.1.1 Alternative Route 1-A

HVDC Alternative Route 1-A is approximately 123 miles long and corresponds to Applicant Proposed Route Links 2, 3, 4, and 5. If this route is selected, 3,003.1 acres would be removed from existing uses, of which 2,554.3 acres (85.0 percent) are agricultural lands (grassland/herbaceous and cultivated crops). HVDC Alternative Route 1-A has a comparable percentage of agricultural land when compared to Links 2 through 5 (2,450.9 acres and 88 percent. Thirteen agricultural structures may need to be removed to construct the transmission line. For the corresponding links of the Applicant Proposed Route one agricultural structure are in the representative ROW.

Outside the representative ROW, tensioning and pulling areas totaling approximately 165.1 acres of primarily grassland/herbaceous would be required during construction.

3.2.6.3.2.1.1.2 Alternative Route 1-B

HVDC Alternative Route 1-B is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2 and 3. If this route is selected, 1,268.4 acres would be removed from existing uses. Of the 1,268.4 acres, approximately 1009.1 acres (79.6 percent) are agricultural land that consists of grassland/herbaceous and cultivated crops. HVDC Alternative Route 1-B has less agricultural land than Links 2 and 3 (1,139.6 acres and 86.6 percent). One agricultural structure is present in the ROW; conversely, no structures are present in Applicant Proposed Route Links 2 and 3.

Outside the representative ROW, tensioning and pulling areas totaling approximately 46.2 acres would be required during construction. The predominant land cover in these areas is grassland/herbaceous. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 1-B.

3.2.6.3.2.1.1.3 Alternative Route 1-C

HVDC Alternative Route 1-C is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2, and 3. If this route is selected, approximately 1,039.1 acres of agricultural land (grassland/herbaceous and cultivated crops) would be removed from existing uses in the representative ROW. HVDC Alternative Route 1-C has a smaller percentage of agricultural land (1,039.1 acres, or 83 percent) than the Applicant Proposed Route Links 2 and Link 3 (1,139.6 acres, or 86.6 percent). Seven agricultural structures are present in the ROW; conversely, no agricultural structures are present in Applicant Proposed Route Links 2 and 3.

Outside the representative ROW, tensioning and pulling areas totaling approximately 60 acres would be required during construction. Approximately 35.8 acres of grassland/herbaceous and 8.3 acres of cultivated crops would be required during construction. The predominant land cover is grassland/herbaceous. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 1-C.

3.2.6.3.2.1.1.4 Alternative Route 1-D

HVDC Alternative Route 1-D is approximately 33.5 miles long and corresponds to Applicant Proposed Route Links 3 and 4. If this route is selected, 819.2 acres would be removed from existing uses. Of the 819.2 acres, approximately 568.9 acres of grassland/herbaceous and 113.2 acres of cultivated crops would be removed from existing uses; no pasture/hay land is present in the representative ROW. Approximately 682.1 acres (83.2 percent) of agricultural land cover are present within the ROW. HVDC Alternative Route 1-D contains a smaller percentage of agricultural land compared to Links 3 and 4 (82.8 acres or 92.8 percent). Three agricultural structures are located in the representative ROW; conversely one agricultural structure is located in the Applicant Proposed Route Link 4.

Outside the representative ROW, tensioning and pulling areas totaling approximately 28.5 acres, approximately 18.0 acres of which are grassland/herbaceous, would be required during construction. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 1-D.

3.2.6.3.2.1.2 Region 2

Table 3.10-24 presents the land cover in the ROW for each of the two HVDC alternative routes in Region 2. Each alternative route is discussed in more detail below.

3.2.6.3.2.1.2.1 Alternative Route 2-A

HVDC Alternative Route 2-A is approximately 57 miles long and corresponds to Applicant Proposed Route Link 2. If this route is selected, approximately 1,396.3 acres would be removed from existing uses. Of the 1,396.3 acres, HVDC Alternative Route 2-A would disturb approximately 1,147.7 acres (82.2 percent) of agricultural land (grassland/herbaceous, cultivated crops, and pasture/hay land). HVDC Alternative Route 2-A contains a greater percentage of agricultural land compared to Link 2 (77.0 percent). Three agricultural structures are located within ROW; conversely, no agricultural structures are present in Link 2.

Outside the representative ROW, tensioning and pulling areas totaling approximately 83.9 acres of primarily grassland/herbaceous and cultivated crops would be required during construction. The predominant land cover is grassland/herbaceous followed by cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 2-A.

3.2.6.3.2.1.2.2 Alternative Route 2-B

HVDC Alternative Route 2-B is approximately 30 miles long and corresponds to Applicant Proposed Route Link 3.If HVDC Alternative Route 2-B is selected, approximately 727.7 acres would be removed from existing uses. Of the 727.7 acres to be removed, approximately 680.3 acres (93.5 percent) are agricultural land (cultivated crops grassland/herbaceous)—more agricultural land than Applicant Proposed Route Link 3. No pasture/hay land is present in the representative ROW. No agricultural structures are present in the representative ROW. Two agricultural structures are present in the Applicant Proposed Route Link 3.

Outside the representative ROW, tensioning and pulling areas totaling approximately 31.2 acres of primarily cultivated crops would be required during construction. The predominant land cover is cultivated crops and no structures are present.

3.2.6.3.2.1.3 Region 3

Table 3.10-25 presents the land cover in the ROW for each of the five HVDC alternative routes in Region 3. Each alternative route is discussed in more detail below.

3.2.6.3.2.1.3.1 Alternative Route 3-A

HVDC Alternative Route 3-A is approximately 38 miles long and corresponds to Applicant Proposed Route Link 1. If this route is selected, 919.1 acres would be removed from existing uses. Of the 919.1 acres to be removed, approximately 497.3 acres of grassland/herbaceous and 150.4 acres of cultivated crops and 5.1 acres of pasture/hay would be disturbed.

The agricultural land cover within the ROW for HVDC Alternative Route 3-A is approximately 71.1 percent (652.8 acres), comparable to the agricultural land cover of HVDC Applicant Proposed Route Link 1. One agricultural structure is present in the representative ROW; however, no agricultural structures are present within the Applicant Proposed Route Link 1.

Outside the representative ROW, tensioning and pulling areas totaling approximately 39.6 acres of primarily grassland/herbaceous would be required during construction. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 3-A.

3.2.6.3.2.1.3.2 Alternative Route 3-B

HVDC Alternative Route 3-B is approximately 48 miles long and corresponds to Applicant Proposed Route Links 1, 2, and 3. For HVDC Alternative Route 3-B, 1,166.6 acres would be removed from existing uses.

The agricultural land cover within the HVDC Alternative Route 3-B representative ROW is approximately 73.3 percent agricultural land (cultivated crops, grassland/herbaceous, and pasture/hay), and contains a larger percentage of agricultural land than Links 1 through 3 (69.0 percent). Two agricultural structures are present in the representative ROW. No agricultural structures are located within the Applicant Proposed Route Links 1, 2, and 3.

Outside the representative ROW, tensioning and pulling areas totaling approximately 84.9 acres agricultural land (primarily grassland/herbaceous) would be required during construction. No agricultural structures are located within the tensioning and pulling areas for HVDC Alternative Route 3-B.

3.2.6.3.2.1.3.3 Alternative Route 3-C

HVDC Alternative Route 3-C is approximately 122 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. For HVDC Alternative Route 3-C, 2,967.5 acres would be removed from existing uses. The agricultural land cover within the representative ROW is approximately 1,980.1 acres (66.8 percent), comparable to Links 3 through 6 (64.3 percent). Six agricultural structures are located within the representative ROW; conversely, two agricultural structures are located within the Applicant Proposed Route Links 3, 4, 5, and 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 220.8 acres (36.3 percent grassland/herbaceous and 23.7 percent pasture/hay) would be required during construction. No agricultural structures are located within the tensioning and pulling areas for HVDC Alternative Route 3-C.

3.2.6.3.2.1.3.4 Alternative Route 3-D

HVDC Alternative Route 3-D is approximately 39 miles long and corresponds to Applicant Proposed Route Links 5 and 6. If this route is selected, 958.8 acres would be removed from existing uses. The agricultural land cover within the representative ROW is approximately 734.2 acres, or 76.6 percent, of agricultural land cover (pasture/hay, grassland/ herbaceous, and cultivated crops). The percentage of agricultural land cover within the representative ROW is comparable to Links 5 and 6 (76.2 percent). Three agricultural structures are present in the representative ROW. Conversely, one agricultural structure is located in the Applicant Proposed Route Links 5 and 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 81.9 acres (46.2 percent pasture/hay) would be required during construction. The predominant land cover is pasture/hay and no structures are present.

3.2.6.3.2.1.3.5 Alternative Route 3-E

HVDC Alternative Route 3-E is approximately 8.5 miles long and corresponds to Applicant Proposed Route Link 6. If this route is selected, 207.8 acres would be removed from existing uses.

HVDC Alternative Route 3-E would disturb approximately 121.5 acres (58.5 percent) of agricultural land (pasture/hay and grassland/herbaceous) within the representative ROW. No agricultural structures are located within the representative ROW. The land cover within the representative ROW contains a higher percentage of agricultural land (58.5 percent) compared to Link 6 of the Applicant Proposed Route, which contains 51.5 percent agricultural land.

No agricultural structures are located within the representative ROW; conversely, one agricultural is located within the Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 25.2 acres of primarily pasture/hay would be required during construction. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 3-E.

3.2.6.3.2.1.4 Region 4

3.2.6.3.2.1.4.1 Alternative Route 4-A

HVDC Alternative Route 4-A is approximately 58 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. HVDC Alternative Route 4-A would disturb approximately 619.3 acres (43.4 percent) of agricultural land (pasture/hay, grassland/herbaceous, and cultivated crops). The agricultural land cover within the representative ROW (43.4 percent) contains a lower percentage of agricultural land compared to Links 3 through 6 (56.7 percent). Seven agricultural structures are located within the representative ROW; conversely, two agricultural structures are located within the Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 189.1 acres would be required during construction. The predominant land cover, or approximately 40.3 percent of the land cover, is pasture/hay. No structures are present within these areas.

3.2.6.3.2.1.4.2 Alternative Route 4-B

HVDC Alternative Route 4-B is approximately 79 miles long and corresponds to Applicant Proposed Route Links 2–8. For HVDC Alternative Route 4-B, 1,919.9 acres would be removed from existing uses. HVDC Alternative Route 4-B would disturb approximately 594 acres of agricultural land (30.9 percent). The agricultural land cover within the representative ROW contains a lower percentage of agricultural land compared to Applicant Proposed Route Links 2–8 (55.6 percent). The majority of HVDC Alternative Route 4-B is located within the boundaries of the Ozark National Forest. Approximately 102 acres of the federally owned land in the Ozark National Forest is within the representative ROW; 157 acres of private land within the Ozark National Forest boundary (use unknown) is within the representative ROW. Nine agricultural structures are located within the representative ROW; conversely, two agricultural structures are located within the Applicant Proposed Route Links 2–8.

Outside the representative ROW, tensioning and pulling areas totaling approximately 198.7 acres (29.0 percent pasture/hay) would be required during construction. The predominant agricultural land cover, or approximately 29.0 percent, is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-B.

3.2.6.3.2.1.4.3 Alternative Route 4-C

HVDC Alternative Route 4-C is approximately 3 miles long and corresponds to Applicant Proposed Route Link 5. For HVDC Alternative Route 4-C, 82.6 acres would be removed from existing uses. HVDC Alternative Route 4-C would disturb approximately 19.0 acres of pasture/hay and 4.8 acres of grassland/herbaceous; no cultivated crops are in the representative ROW. No agricultural structures would be removed to construct the transmission line.

The land cover within the representative ROW contains approximately 23.8 acres of agricultural land (29 percent), a percentage that is lower to Applicant Proposed Route Link 5 (28.8 percent). No agricultural structures are located within the representative ROW; similarly, no agricultural structures are present in the Applicant Proposed Route Link 5.

Outside the representative ROW, tensioning and pulling areas totaling approximately 25.9 percent pasture/hay would be required during construction. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-C.

3.2.6.3.2.1.4.4 Alternative Route 4-D

HVDC Alternative Route 4-D is approximately 25 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. For HVDC Alternative Route 4-D, a total of 617.6 acres would be removed from existing uses. Approximately 319.4 acres (51.7 percent) of agricultural land would be removed from existing uses.

The percentage of agricultural land cover within the representative ROW (51.7 percent) is less than Links 4 – 6 (58.0 percent). Six agricultural structures are located within the representative ROW. Conversely, two agricultural structures are present in the Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning and pulling areas approximately 47.2 percent pasture/hay would be required during construction. The predominant land covers are pasture/hay and deciduous forest. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-D.

3.2.6.3.2.1.4.5 Alternative Route 4-E

HVDC Alternative Route 4-E is approximately 37 miles long and corresponds to Applicant Proposed Route Links 8 and 9. For HVDC Alternative Route 4-E, 897.2 acres would be removed from existing uses. HVDC Alternative Route 4-E would disturb approximately 410.7 acres (45.8 percent) of agricultural land cover.

The percentage of agricultural land cover (45.8 percent) within the representative ROW is lower than Links 8 and 9 (or approximately 48.6 percent). Two agricultural structures are present within the representative ROW; similarly, two agricultural structures are present in the Applicant Proposed Route Link 9.

Outside the representative ROW, tensioning and pulling areas totaling approximately 147.2 acres would be required during construction. The predominant land cover, or approximately 49.7 percent, is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-E.

3.2.6.3.2.1.5 Region 5

3.2.6.3.2.1.5.1 Alternative Route 5-A

HVDC Alternative Route 5-A is approximately 13 miles long and corresponds to Applicant Proposed Route Link 1. For HVDC Alternative Route 5-A, 308.5 acres would be removed from existing uses. HVDC Alternative Route 5-A would disturb approximately 66.6 acres (21.6 percent) agricultural land (pasture/hay and grassland/herbaceous) are in the representative ROW.

The percentage of agricultural land cover within the representative ROW is comparable to Applicant Proposed Route Link 1 (approximately 21.6 percent agricultural land). No structures are located in the representative ROW, as is the case for Applicant Proposed Route Link 1.

Outside the representative ROW, tensioning and pulling areas totaling approximately 65.4 acres would be required during construction. Only 13.4 of these acres are agricultural (grassland/herbaceous or pasture/hay) in nature. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-A.

3.2.6.3.2.1.5.2 Alternative Route 5-B

HVDC Alternative Route 5-B is approximately 71 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. For HVDC Alternative Route 5-B, 1,732.3 acres would be removed from existing uses. HVDC Alternative Route 5-B would disturb approximately 861.5 acres, or 49.7 percent, agricultural land (740.3 acres of pasture/hay, 42.0 acres of cultivated crops, and 79.2 acres of grassland/herbaceous).

The land cover within the representative ROW contains approximately 861.5 acres (or 49.7 percent) agricultural land, which is greater than the percentage of agricultural land for Links 3 through 6 (approximately 39.4 percent). One agricultural structure is located within the representative ROW. Conversely, there are no agricultural structures located within the Applicant Proposed Route Links 3 through 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 220.9 acres would be required during construction. The predominant land cover is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-B.

3.2.6.3.2.1.5.3 Alternative Route 5-C

HVDC Alternative Route 5-C is approximately 9 miles long and corresponds to Applicant Proposed Route Links 6 and 7. For HVDC Alternative Route 5-C, 224.6 acres would be removed from existing uses. HVDC Alternative Route 5-C would disturb approximately 81.8 acres of agricultural land (70.9 acres of pasture/hay, 10.7 acres of grassland/herbaceous, and 0.2 acre of cultivated crops).

The land cover within the representative ROW contains approximately 81.8 acres (36.4 percent) agricultural land. Agricultural land cover within the representative ROW is higher than the percentage in Applicant Proposed Route Links 6 and 7 (32.8 percent). One agricultural structure is present in the representative ROW; conversely, one structure is present in Applicant Proposed Route Link 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 54.0 acres would be required during construction. The predominant land cover, or approximately 47.6 percent, is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-C.

3.2.6.3.2.1.5.4 Alternative Route 5-D

HVDC Alternative Route 5-D is approximately 22 miles long and corresponds to Applicant Proposed Route Link 9. For HVDC Alternative Route 5-D, 529.6 acres would be removed from existing uses. HVDC Alternative Route 5-D would disturb approximately 144.6 acres or 27.3 percent of agricultural land (cultivated crops, pasture/hay, and grassland/herbaceous.) No agricultural structures are present in the representative ROW.

The percentage of agricultural land cover within the representative ROW, or 27.3 percent, is lower than the Applicant Proposed Route Link 9, which contains approximately 46.7 percent agricultural land. No agriculture structures are present in the representative ROW, as is the case in the Applicant Proposed Route Link 9.

Outside the representative ROW, tensioning and pulling areas totaling approximately 89.3 acres would be required during construction, of which approximately 21.0 percent is cultivated crops. No agricultural structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-D.

3.2.6.3.2.1.5.5 Alternative Route 5-E

HVDC Alternative Route 5-E is approximately 36 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. For HVDC Alternative Route 5-E, approximately 885.1 acres would be removed from existing uses. HVDC Alternative Route 5-E would disturb approximately 467.2 acres (or 52.7 percent) of agricultural land (pasture/hay, cultivated crops, and grassland/herbaceous). The percentage of agricultural land cover within the representative ROW is higher than Links 4–6, or 44.2 percent. One agricultural structure is present in the representative ROW. Conversely, no agricultural structures are located in the Applicant Proposed Route Links 4, 5, and 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 88.4 acres would be required during construction, of which is predominantly 45.8 percent is pasture/hay. The predominant land cover is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-E.

3.2.6.3.2.1.5.6 Alternative Route 5-F

HVDC Alternative Route 5-F is approximately 22 miles long and corresponds to Applicant Proposed Route Links 5 and 6. For HVDC Alternative Route 5-F, 544.5 acres would be removed from existing uses. HVDC Alternative Route 5-F would disturb approximately 258.4 acres or 47.5 percent of agricultural land (pasture/hay, cultivated crops, and grassland/herbaceous). No agricultural structures would need to be removed to construct the transmission line.

The percentage of agricultural land cover (47.5 percent) within the representative ROW is greater than the percentage within the Applicant Proposed Route Links 5 and 6 (32.2 percent). No agricultural structures are present in the representative ROW. No agricultural structure is present in Link 5 and one other structure is present in Link 6.

Outside the representative ROW, tensioning and pulling areas totaling approximately 52.1 acres, of which 43.2 percent is pasture/hay, would be required during construction. No structures are present in the tensioning and pulling areas for Alternative Route 5-F.

3.2.6.3.2.1.6 Region 6

3.2.6.3.2.1.6.1 Alternative Route 6-A

HVDC Alternative Route 6-A is approximately 16 miles long and corresponds to Applicant Proposed Route Links 2, 3, and 4. For HVDC Alternative Route 6-A, 395.7 acres would be removed from existing uses. HVDC Alternative Route 6-A would disturb approximately 328.6 acres or 83.0 percent of agricultural land, all of which is cultivated crops in the representative ROW. The agricultural land cover within the representative ROW is composed entirely of cultivated crops (83.0 percent), a percentage that is lower than the corresponding links 2 through 4 of the Applicant Proposed Route (87.4). No agricultural structures are located in the representative ROW; conversely, one agricultural structure is present in Link 4.

Outside the representative ROW, tensioning and pulling areas totaling approximately 62.5 acres would be required during construction. The predominant land cover, or approximately 79.7 percent, is cultivated crops. No structures are present in the tensioning and pulling areas for Alternative Route 6-A.

3.2.6.3.2.1.6.2 Alternative Route 6-B

HVDC Alternative Route 6-B is approximately 14 miles long and corresponds to Applicant Proposed Route Link 3. HVDC Alternative Route 6-B would disturb approximately 272.1 acres (79.2 percent) of agricultural land, which is all cultivated crops, in the representative ROW. For HVDC Alternative Route 6-B, 343.7 acres would be removed from existing uses. The percentage of agricultural land cover within the representative ROW is approximately 79.2 percent, compared to 84.1 percent agricultural land in the Applicant Proposed Route Link 3. No agricultural structure is located within the representative ROW for HVDC Alternative Route 6-B; no agricultural structures are present in the Applicant Proposed Route Link 3.

Outside the representative ROW, tensioning and pulling areas totaling approximately 32.3 acres would be required during construction. The predominant land cover is cultivated crops (79.7 percent). No structures are present in the tensioning and pulling areas for Alternative Route 6-B.

3.2.6.3.2.1.6.3 Alternative Route 6-C

HVDC Alternative Route 6-C is approximately 23 miles long and corresponds to Applicant Proposed Route Links 6 and 7. For HVDC Alternative Route 6-C, approximately 565.6 acres would be removed from existing uses. HVDC Alternative Route 6-C would disturb approximately 430.6 acres (or 76.1 percent) of agricultural land (cultivated crops and pasture/hay) are present in the representative ROW. The land cover within the representative ROW contains approximately 430.6 acres or 76.1 percent of agricultural land, which is higher than the percentage in Links 6 and 7 (71.7 percent). One agricultural structure is present in the representative ROW; conversely, four agricultural structures are present in Applicant Proposed Route Link 6, and no agricultural structures are present in Link 7.

Outside the representative ROW, tensioning and pulling areas totaling approximately 50.7 acres would be required during construction. The predominant land cover, or 69.2 percent, is cultivated crops. No structures are present in the tensioning and pulling areas for Alternative Route 6-C.

3.2.6.3.2.1.6.4 Alternative Route 6-D

HVDC Alternative Route 6-D is approximately 9 miles long and corresponds to Applicant Proposed Route Link 7. For HVDC Alternative Route 6-D, 223.6 acres would be removed from existing uses. HVDC Alternative Route 6-D would disturb approximately 205.3 acres (91.8 percent) of agricultural lands, all of which is cultivated crops, in the representative ROW.

The land cover within the representative ROW contains approximately 205.3 acres or 91.8 percent agricultural land, similar to that of Applicant Proposed Route Link 7 (92.3 percent). No agricultural structures are present in the representative ROW, as is the case with the Applicant Proposed Route Link 7.

Outside the representative ROW, tensioning and pulling areas totaling approximately 17.8 acres of primarily cultivated crops or 87.8 percent, would be required during construction. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for Alternative Route 6-D.

Outside the representative ROW, tensioning and pulling areas totaling approximately 17.8 acres of primarily cultivated crops, or 87.8 percent, would be required during construction.

3.2.6.3.2.1.7 Region 7

3.2.6.3.2.1.7.1 Alternative Route 7-A

HVDC Alternative Route 7-A is approximately 43 miles long and corresponds to Applicant Proposed Route Link 1. For HVDC Alternative Route 7-A, 1052.0 acres would be removed from existing uses. HVDC Alternative Route 7-A would disturb approximately 828.8 acres (78.8 percent) of agricultural lands, which the majority are cultivated crops, in the representative ROW. The land cover within the representative ROW contains approximately 78.8 percent agricultural lands, similar to that of Applicant Proposed Route Link 1 (78.1 percent). No structures are present in the representative ROW. Conversely, one other structure is present in Applicant Proposed Route Link 1.

Outside the representative ROW, tensioning and pulling areas totaling approximately 165.9 acres of primarily cultivated crops, or 83.8 percent, would be required during construction. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 7-A.

3.2.6.3.2.1.7.2 Alternative Route 7-B

HVDC Alternative Route 7-B is approximately 9 miles long and corresponds to Applicant Proposed Route Links 3 and 4. For HVDC Alternative Route 7-B, 209.9 acres would be removed from existing uses. HVDC Alternative Route 7-B would disturb approximately 120.4 acres or 57.4 percent of agricultural land (cultivated crops and pasture/hay) in the representative ROW.

The land cover within the representative ROW contains approximately 57.4 percent agricultural land, which is higher than the percent of agricultural land within the Applicant Proposed Route Links 3 and 4 (52.9 percent). No agricultural structures are present in the representative ROW; no agricultural structures are located within Links 3 and 4 and would not need to be removed in Links 3 and 4.

Outside the representative ROW, tensioning and pulling areas totaling approximately 53.9 acres would be required during construction. The predominant, or approximately 52.8 percent, land cover is cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 7-B.

3.2.6.3.2.1.7.3 Alternative Route 7-C

HVDC Alternative Route 7-C is approximately 24 miles long and corresponds to Applicant Proposed Route Links 3, 4, and 5. If this route is selected, 578.6 acres would be removed from existing uses. HVDC Alternative Route 7-C would disturb approximately 422.8 acres of agricultural land (cultivated crops and pasture/hay) in the representative ROW. The land cover within the representative ROW contains approximately 73.1 percent agricultural lands, a percentage that is higher than Applicant Proposed Route Links 3 - 5 (52.6 percent). No agricultural structures are present in the representative ROW; conversely, two agricultural structures are present in Applicant Proposed Route Link 5.

Outside the representative ROW, tensioning and pulling areas totaling approximately 112.1 acres would be required during construction. The predominant, or approximately 64.9 percent, land cover is cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 7-C.

3.2.6.3.2.1.7.4 Alternative Route 7-D

HVDC Alternative Route 7-D is approximately 7 miles long and corresponds to Applicant Proposed Route Links 4 and 5. For HVDC Alternative Route 7-D, 159.5 acres would be removed from existing uses. HVDC Alternative Route 7-D would disturb approximately 109.0 acres or 68.3 percent of agricultural land (cultivated crops and pasture/hay) in the representative ROW. The land cover within the representative ROW is approximately 68.3 percent agricultural lands, and is higher than the percentage of agricultural lands in Applicant Proposed Route Links 4 and 5 (63.5 percent). No structures are located in the representative ROW; conversely two agricultural structures may be removed in Link 5.

Outside the representative ROW, tensioning and pulling areas totaling approximately 30.1 acres would be required during construction. The predominant, or 59.5 percent, land cover is cultivated crops. No structures exist in the tensioning and pulling areas for HVDC Alternative Route 7-D.

3.2.6.3.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance of the HVDC alternative routes would be similar to those from the Applicant Proposed Route (see Section 3.2.6.2.3). The long-term impacts by region are summarized in Table 3.10-31 for pole structures. No permanent impacts are described for access roads because the location of the access roads has not been determined at this time.

3.2.6.3.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could be returned to the preconstruction land uses described in Sections 3.2.4 and 3.2.5.

3.2.6.4 Best Management Practices

No BMPs are identified for this section. It should be noted that the Applicant has developed a comprehensive list of EPMs for the Project. A complete list of EPMs for the Project is provided in Appendix F. The EPMs would avoid or minimize potential impacts to agricultural resources.

3.2.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts could occur if agricultural structures could not be avoided. Yields from lands used for crops, pasture/hay, and grazing livestock would be temporarily affected in the construction areas, and land used for transmission structures, long-term access roads, and converter stations would be removed from agricultural production until the Project was decommissioned.

3.2.6.6 Irreversible and Irretrievable Commitment of Resources

Upon decommissioning of the Project, all land could return to previous uses. There would be no irreversible or irretrievable commitment of agricultural resources.

3.2.6.7 Relationship between Local Short-term Uses and Long-term Productivity

The conversion of primarily agricultural land to an industrial use to construct and operate the Project would result in short-term use impacts. These direct effects would include the loss of crops pasture/hay and grazing land for livestock in the representative ROW as well as loss of agricultural structures. Other short-term and localized impacts include the disruption of access to local agricultural land uses during construction. The productivity of the soil in temporary construction areas may also be reduced due to compaction and soil erosion.

The short-term impacts would be minimized, however, because of multiple EPMs incorporated into the Project:

- Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures (LU-4).
- Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties (LU-5).
- Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations (GE-3).
- Clean Line will work with landowners to avoid and minimize impacts to residential landscaping (LU-3).
- Clean Line will minimize the frequency and duration of road closures (LU-2).
- Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases) (LU-1).

Additional Applicant EPMs that should ensure long-term productivity of land in the representative ROW include:

- Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1).
- Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments (AG-2).

- Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands. (AG-3).
- Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms (AG-4).
- Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., aerial crop spraying) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. Clean Line will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure (AG-5).
- Clean Line will work with landowners to develop compensation for lost crop value caused by construction and/or maintenance (AG-6).
- Clean Line will stabilize slopes exposed by its activities to minimize erosion (GEO-1).

3.2.6.8 Connected Actions

3.2.6.8.1 Wind Energy Generation

The primary existing land use in the 12 WDZs is agriculture. Sections 3.2.6.8.1.1 through 3.2.6.8.1.12 provide more detailed information on the type of agricultural land impacted by the WDZs. It is estimated that during the construction phase, approximately 2 percent of land within a wind energy facility is affected (Denholm et al. 2009). Assuming between 20 and 30 percent of the WDZs would be built-out, between 4,328 and 6,492 acres of primarily agricultural land would be temporarily affected during construction.[1] Wind farm developers are typically able to micro-site turbines and other facility components to avoid displacing or damaging agricultural structures such as irrigation equipment, barns, and silos.

During the operations and maintenance phase of wind energy facilities, approximately 1 percent or less of the land is affected or disturbed. Assuming 20 to 30 percent build-out for the 12 WDZs, a total of 2,164 to 3,246 acres of primarily agricultural land would be affected for the life of the Project (1 percent of the 20 percent for the low end, 1 percent of the 30 percent for the high end). Impacts to agricultural lands and soils would be similar to those discussed above for Project components, and a typical wind energy project could include similar EPMs.

Landowners could benefit financially from a wind farm through lease payments when turbines are sited on their lands. Given their relatively small footprints, wind turbines do not substantially decrease the land available for agricultural purposes, allowing landowners to benefit financially from lease payments and agriculture. Wind lease agreements typically include provisions to minimize the losses, including minimizing soil compaction and revegetating temporary work areas. In addition, the agreements typically stipulate compensation for landowners for any losses, such as damage or loss of crops, gates, fences, landscaping and trees, irrigation, and livestock.

[1] Approximately 20 to 30 percent of the 1,082,000 acres suitable for wind development would be built out (or between 216,400 and 324,600 acres). During the construction phase, approximately 2 percent of the total acreage would be disturbed. For the low end of the range, 2 percent of 216,400 is 4,328 acres. For the high end, 2 percent of 324,600 is 6,492 acres.

Once construction has been completed, agricultural operations would be able to continue in most of the wind farm. Agricultural activities such as cultivating crops and livestock grazing are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be removed from production for the life of the Project, although long-term access roads and the configuration of wind turbines may change the configuration of fields for crops and grazing.

3.2.6.8.2 Optima Substation

The future Optima substation is anticipated to be constructed on 160 acres of currently undeveloped land near an operating wind energy facility. The land cover of the site is primarily grassland/herbaceous. Any agricultural practices, such as grazing, that currently occur on the site would be converted to a utility use.

3.2.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

The TVA upgrades, like the Project, are linear projects with the exception of substation modifications and relatively small amounts of ground disturbance considering the amount of area crossed. Upon completion of construction, much of the affected agricultural land could return to previous uses. Much of the following discussion is only relevant to the new 500 kV transmission line, or for certain upgrades associated with the 161 kV transmission lines. The TVA upgrades to existing facilities (including existing transmission lines and existing substations) should have minimal impacts to agricultural resources as ground disturbance is typically limited to the immediate vicinity of the structure.

Upgrades required to interconnect into the TVA transmission grid could involve new disturbance of agricultural lands. Potential impacts to agricultural resources for the new transmission line, upgrades to existing lines, and modifications to substations would be similar to impacts described in detail in Section 3.2.6 for the Project. Impacts during construction could involve loss of vegetation and soil at construction sites and along travel routes; possible temporary loss of the use of structures such as barns, ponds, and silos; and possible curtailment of actions such as animal feeding operations. These types of impacts likely would be short term for the new 500 kV transmission line, although it is possible that loss of the use of structures could be long term. Potential agricultural impacts associated with the required upgrades to existing TVA facilities are not anticipated to result in significant impacts to agricultural land. The degree of potential impacts associated with the new electric transmission line would depend on the types of agriculture within the existing transmission line ROW. For the upgrades to existing structures, ground disturbance is typically limited to the immediate vicinity of the structure.

The majority of the ROW would be disturbed during construction for both the new transmission line and the upgrades to existing facilities. Areas of fully dedicated uses (e.g., sites of converter stations, structures, and permanent access roads) would experience longer-term impacts than ROW areas, where existing land use may continue after construction.

During operations and maintenance of the new 500 kV transmission line and upgraded electrical transmission lines, agricultural activities could resume to a large extent on most disturbed areas, but some constraints and limitations would be likely, such as land use limitations within ROWs, physical interference with agricultural equipment operations, and periodic loss of access during maintenance activities. These impacts are long-term impacts. Also during operations, long-term transmission structures could affect aerial spraying activities often used in agricultural areas. This effect could involve requiring the spraying to be performed at higher altitudes resulting in more chance for overspray or drift that could affect adjoining properties, or it could eliminate aerial spraying in some areas. Effects on the economic value of livestock production could occur through a combination of decreasing forage land available and by increasing management costs of controlling noxious and invasive vegetation species introduced during construction and costs of moving livestock around project-related structures and ROWs. Anticipated effects from upgrades to existing structures, conductor, or substations would be expected to include ground disturbance that is typically limited to the immediate vicinity of the structure, and no changes to the existing utility use.

3.2.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. There would be no impacts on agricultural land or resources. The existing agricultural activity throughout the regions would be expected to continue.

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Contents

Figures Presented in Appendix A

Tables

3.3 Air Quality and Climate Change

This section addresses potential air quality and climate change impacts from the Project and alternatives during construction, operation, and decommissioning. Emissions of air pollutants from the Project would primarily be generated from the following activities:

- Construction of on- and off-ROW access roads
- Construction of the support structure pad sites and structure erection
- Post-construction activities involved with the ongoing use and maintenance of the transmission line, converter stations, and corridor

Air quality in a given location is determined by the concentration of various pollutants in the atmosphere. Air pollutants can be divided into three categories: criteria air pollutants for which EPA has established National Ambient Air Quality Standards [NAAQS] to protect health and welfare, toxic air pollutants (chemicals and chemical classes which have carcinogenic, mutagenic, or other hazardous effects), and greenhouse gases (GHGs) (gases that have been identified as the main cause of observed global climate change) (NCADAC 2013).

3.3.1 Regulatory Background

3.3.1.1 Federal

Federal air pollution regulations focus largely on criteria and toxic pollutants and include provisions applicable to stationary and mobile sources.

For criteria pollutants, NAAQS represent maximum levels of background pollution that are considered safe. Primary standards protect public health, including the health of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards protect public welfare, including protecting against decreased visibility and damage to animals, crops, vegetation, and buildings. Pursuant to the CAA, EPA has established NAAQS for ambient concentrations of ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM_{10} [i.e., particulate matter 10 microns or smaller in diameter] and $PM_{2.5}$,]), and airborne lead. NAAQS represent maximum acceptable concentrations that generally may not be exceeded more than once per year, except the annual standards, which may never be exceeded. The federal CAA amendments of the 1990s require states to control air pollution emission sources so that NAAQS are met and maintained. An area that does not meet the NAAQS is designated as a nonattainment area on a pollutant-by-pollutant basis.

Toxic air pollutants cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The Clean Air Act currently requires EPA to regulate 187 toxic air pollutants. In contrast to the geographically based approach used for criteria pollutants, for toxic air pollutants, EPA has identified major industrial sources that emit these pollutants and developed national technology-based performance standards to significantly reduce their emissions.

A substantial amount of construction activity would occur with the Project, and fuel-fired construction equipment is a mobile source of air pollution. Mobile sources of air pollution are primarily regulated at the point of manufacture (manufacturers have been required to meet increasingly stringent emissions requirements in 40 CFR Parts 86, 89, 90, 1039, and 1048) and fuels are regulated at the fuel supplier end (40 CFR Part 80 requirements apply to criteria air pollutants and toxics, and include Renewable Fuels Standard requirements to address GHG emissions). Mobile sources can also trigger the need for a General Conformity determination (40 CFR Part 93, Subpart B) if they are emitting sufficiently large quantities of an air pollutant in an area designated “nonattainment” with respect to a current

NAAQS, or which was previously designated "nonattainment" with respect to a current NAAQS (and is therefore a "maintenance" area). In such areas, a federal agency must make a determination that permitting or approving an activity will conform to the state implementation plan when the total of direct and indirect emissions (of the nonattainment/maintenance pollutant, or its precursors) in that area would equal or exceed *de minimis* levels identified in 40 CFR Part 93 Subpart B, which vary depending on the pollutant and attainment status but are no higher than 100 TPY.

3.3.1.2 State

The Project would cross through portions of Oklahoma, Arkansas, Tennessee, and Texas, with each state providing regulations for air pollutant emissions. Generally each state's ambient air quality standards are the same as the NAAQS.

3.3.2 Data Sources

Data sources used to evaluate the affected environment for air quality and climate change, as well as assess air quality and climate change impacts, include the following:

- Historical meteorological data from the National Oceanic and Atmospheric Administration's National Climatic Data Center (NCDC 2014)
- EPA AirData archived historical ambient air quality measurements (GIS Data Source: EPA 2014)
- CAA attainment designations (42 USC § 7401 et seq.)
- U.S. Global Climate Change Research Program (GCCRP) climate assessments (GCCRP 2014)
- Clean Line-required construction equipment (Appendix F)
- Clean Line-required operational equipment (Appendix F)
- EPA emission factors for stationary point and area sources (EPA 2008)
- EPA NONROAD2008a emissions model (EPA 2009)
- EPA Motor Vehicle Emissions Simulator (MOVES) 2010b emissions model (EPA 2012)
- EPA Air Quality Monitoring Stations (GIS Data Source: EPA 2014)

3.3.3 Region of Influence

For air quality, the ROI for the Applicant Proposed Route, DOE Alternatives, and connected actions are generally the same as Section 3.1.1. However, for criteria air pollutants, to be conservative the ROI has been extended to approximately 300–500 feet from the roadway (CARB 2005). The reason for the expansion of the ROI is to provide an added level of conservatism in the analysis of air quality impacts to sensitive areas. The ROI includes sensitive areas including residential areas and schools. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Appendix E lists specific air quality concerns expressed during public scoping which are evaluated for each region of the Project.

GHGs are a global issue, involving pollutants that have relatively long lifetimes in the atmosphere and that accumulate over time. Science has not yet progressed to the point where localized impacts from GHGs as a whole can be quantitatively predicted (Kerr 2013), and GHG emissions that result from construction activities by themselves are likely to have a negligible impact on current GHG concentrations because the current concentrations reflect accumulations of pollutants over time and are therefore many orders of magnitude higher than the contribution of

GHGs from the Project. GHGs are primarily of interest because of the cumulative impacts (i.e., from all sources) on global climate, as will be discussed in more detail in Section 3.3.4.

3.3.4 Affected Environment

As mentioned previously, air pollutants can be divided into three classes: criteria pollutants, toxic pollutants, and GHGs. The seven air pollutants listed below are criteria pollutants for which EPA has developed NAAQS:

- SO_2
- CO
- NO_2
- O_3
- PM_{10}
- $PM_{2.5}$
- Lead and its compounds (measured as lead)

Precursors to criteria pollutants include those that cause the formation of the pollutant after they are emitted; for example, O_3 in the ambient air is predominantly formed by photochemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOCs).

Concentrations of pollutants in the ambient air vary over time and therefore many of the NAAQS (Table 3.3-1) are focused on statistical functions (98th percentile concentrations, 99th percentile concentrations, etc.). They also vary spatially, so a network of air quality monitoring stations is used to assess regional air quality (see Figure 3.3-1 in Appendix A) to determine whether counties should be designated as “attainment” or “nonattainment” with respect to the NAAQS. For any particular NAAQS, if an area previously designated as “nonattainment” is redesignated as “attainment,” it is classified as a “maintenance” area (i.e., the subset of attainment areas that were previously designated as nonattainment for that standard). As identified in 40 CFR 81, the entire ROI has been designated as attainment for all of the NAAQS, with the exception of Shelby County, Tennessee (containing the city of Memphis), which is designated “marginal” nonattainment for ozone and is a maintenance area for CO.

Each of the criteria pollutants listed in Table 3.3-1 except ozone are emitted directly; ozone can also be emitted directly by a few sources but is predominantly a result of reactions between NO_x—predominantly NO_2 and nitrogen oxide (NO)—and VOCs in the air, particularly in the warmer months. For this reason, criteria pollutant emissions inventories include NO_x and VOCs, even though they are not criteria pollutants themselves.

Table 3.3-1:
Criteria Pollutants, National Ambient Air Quality Standards

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS
SO_2 (ppb)	1-Hour [1]	75	NA
	3-Hour	NA	500
CO (ppm)	1-Hour [2]	35	NA
	8-Hour [2]	9	NA
NO_2 (ppb)	1-Hour [3]	100	NA
	Annual	53	53
Ozone (ppm)	8-Hour [4]	0.075	0.075

Table 3.3-1:
Criteria Pollutants, National Ambient Air Quality Standards

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS
PM_{10} ($\mu g/m^3$)	24-Hour [5]	150	150
$PM_{2.5}$ ($\mu g/m^3$)	24-Hour [6]	35	35
	Annual [7]	12.0	15.0
Lead ($\mu g/m^3$)	3-Month [8]	0.15	0.15

$\mu g/m^3$ = micrograms per cubic meter
ppb = parts per billion
ppm = parts per million
1 NAAQS applies to the 3-year average of the annual (99th percentile) of the daily maximum1-hour average concentration.
2 NAAQS is not to be exceeded more than once per calendar year.
3 NAAQS applies to the 3-year average of the annual (98th percentile) of the daily maximum 1-hour average concentration.
4 NAAQS applies to the 3-year average of the annual 4th highest daily maximum 8-hour average concentration.
5 Not to be exceeded more than once per year on average over 3 years.
6 NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
7 NAAQS applies to the 3-year average of annual concentrations.
8 NAAQS applies to the maximum arithmetic 3-month mean.

While the scientific understanding of climate change continues to evolve, the Intergovernmental Panel on Climate Change Fifth Assessment Report has stated that warming in the of the Earth's climate is unequivocal, that continued emissions of GHGs will cause further warming and changes in all of the components of the climate system, and that limiting climate change will require substantial and sustained reductions of GHG emissions (IPCC 2013). The report also states that it is "virtually certain" that there will be more frequent hot and fewer cold temperature extremes over most land areas on daily and seasonal timescales as global mean temperatures increase, that it is "very likely" that heat waves will occur with a higher frequency and duration, that the global ocean will continue to warm during the 21st century, that global mean sea level will continue to rise during the 21st century, and that most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped (IPCC 2013). GHGs include CO_2, methane (CH_4), and nitrous oxide (N_2O). No specific "ambient standards" exist for these pollutants, but for context, total U.S. anthropogenic (human-caused) GHG emissions were 6,576 million metric tonnes carbon dioxide equivalent (CO_2e) in 2009, and 40 percent of these were from the electric power sector (EIA 2011). Unlike criteria pollutants and air toxics, GHG concentrations have been increasing over time, and are continuing to increase. Although there are not localized monitoring networks, 2011 average concentrations of CO_2, CH_4, and N_2O were 391 ppm, 1,803 parts per billion, and 324 parts per billion, respectively, meaning that they exceeded pre-industrial levels (year 1750) by about 40 percent, 150 percent, and 20 percent, respectively (IPCC 2013). The Intergovernmental Panel on Climate Change (2013) has concluded that it is "likely" (66–100 percent probability) that GHGs contributed a global mean surface warming in the range of 0.5 C to 1.3 C over the period 1951 to 2010 and "extremely likely" (95–100 percent probability) that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together.

3.3.4.1 Meteorological Conditions

Locally, the climate of the ROI varies by state depending largely on proximity to large waterbodies and mountain ranges (NCDC 2014). The portion of the ROI in Oklahoma and the Texas Panhandle experience extreme temperature changes, especially in the winter months, from cold fronts moving west to east after crossing the Rocky Mountains. The Oklahoma and Texas panhandles represent the driest portions of the ROI. Arkansas' climate is generally warmer and more humid in the lowlands than in the mountainous regions. Arkansas rarely incurs drought conditions given the relatively consistent annual precipitation. The Shelby County, Tennessee, portion of the ROI has similar meteorological conditions to those of the Arkansas lowlands.

3.3.5 Regional Description

Tables 3.3-2 through 3.3-8 provide existing air quality monitoring data for criteria air pollutants for stations located within or in relatively close proximity to each of the regions (GIS Data Source: EPA 2014). Generally, the monitoring stations are located in populated areas and therefore the reported concentrations may be higher than those in the more rural areas where project construction is occurring. The following subsections provide a brief description of each region's topography and meteorology. Topography and meteorology affect how air moves. For example, mountainous regions can act as barriers between air pollution concentrations and other areas.

3.3.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D. The area is generally flat with temperature extremes resulting from weather patterns moving west to east after crossing the Rocky Mountains (NCDC 2014). Existing air quality monitoring for Region 1 is summarized in Table 3.3-2. Generally, the monitoring stations are sited in populated areas and, as a result, criteria pollutant levels in more rural areas of Region 1 are likely lower than those obtained by the nearest monitoring stations. Region 1 is rural in nature with limited development.

Table 3.3-2:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 1

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data [9]
SO_2 (ppb)	1-Hour [1]	75	NA	Oklahoma County, OK	127	5.3
	3-Hour	NA	500			[10]
CO (ppm)	1-Hour [2]	35	NA	Oklahoma County, OK	127	1.37
	8-Hour [2]	9	NA			0.8
NO_2 (ppb)	1-Hour [3]	100	NA	Oklahoma County, OK	127	54
	Annual	53	53			[10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Dewey County, OK	40	0.074
PM_{10} (μg/m^3)	24-Hour [5]	150	150	Ford County, KS	70	58
$PM_{2.5}$ (μg/m^3)	24-Hour [6]	35	35	Oklahoma County, OK	127	20
	Annual [7]	12.0	15.0	Oklahoma County, OK	127	10
Lead (μg/m^3)	3-Month [8]	0.15	0.15	Amarillo, TX	115	EPA AirData does not publish data

μg/m^3 = micrograms per cubic meter
ppb = parts per billion
ppm = parts per million
1 NAAQS applies to the 3-year average of the annual (99th percentile) of the daily maximum1-hour average concentration.
2 NAAQS is not to be exceeded more than once per calendar year.
3 NAAQS applies to the 3-year average of the annual (98th percentile) of the daily maximum 1-hour average concentration.
4 NAAQS applies to the 3-year average of the annual 4th highest daily maximum 8-hour average concentration.
5 Not to be exceeded more than once per year on average over 3 years.

6 NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
7 NAAQS applies to the 3-year average of annual concentrations.
8 NAAQS applies to the maximum arithmetic 3-month mean.
9 Data for 2013 have not yet been quality-assured/finalized; therefore, the data shown are for 2010–2012 (and exclude exception events per 40 CFR 50.14). The values in this column for the Seiling, Oklahoma, station data were obtained from the state's 2012 Annual Monitoring Report http://www.deq.state.ok.us/aqdnew/airreport2012/2012o3.html and for remaining sites not included in Oklahoma's annual report data were obtained from EPA AirData (GIS Data Source: EPA 2014).
10 These averages not tabulated, since highest one-hour concentrations are well below the average standard.

3.3.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. Like Region, 1 it is generally flat with temperature extremes resulting from weather patterns moving west to east after crossing the Rocky Mountains (NCDC 2014). Existing air quality monitoring for Region 2 is provided in Table 3.3-3. Generally, the monitoring stations are sited in populated areas and, as a result, criteria pollutant levels in Region 2 may be lower than those obtained by the nearest monitoring stations. The area is rural and development is limited.

Table 3.3-3:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 2

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data [9]
SO_2 (ppb)	1-Hour [1]	75	NA	Oklahoma County, OK	40	5.3
	3-Hour	NA	500			[10]
CO (ppm)	1-Hour [2]	35	NA	Oklahoma County, OK	40	1.37
	8-Hour [2]	9	NA			0.8
NO_2 (ppb)	1-Hour [3]	100	NA	Oklahoma County, OK	40	54
	Annual	53	53			[10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Dewey County, OK	9	0.074
PM_{10} (µg/m³)	24-Hour [5]	150	150	Oklahoma County, OK	40	59
$PM_{2.5}$ (µg/m³)	24-Hour [6]	35	35	Oklahoma County, OK	40	20
	Annual [7]	12.0	15.0	Oklahoma County, OK	40	10
Lead (µg/m³)	3-Month [8]	0.15	0.15	Tulsa, OK	97	0.008

For table notes, see Table 3.3-2.

3.3.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. The area, much like Regions 1 and 2, is generally flat, although at the Oklahoma-Arkansas border there are some mountainous areas coinciding with the Ouachita Mountains. Temperature extremes result from weather patterns moving west to east after crossing the Rocky Mountains (NCDC 2014). Existing air quality monitoring for Region 3 is provided in Table 3.3-4. Although all three monitoring stations show ozone concentrations in excess of the NAAQS, the area has not been redesignated as “nonattainment” for ozone.

Table 3.3-4:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 3

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data [9]
SO_2 (ppb)	1-Hour [1]	75	NA	Oklahoma County, OK	29	5.3
	3-Hour	NA	500			[10]
CO (ppm)	1-Hour [2]	35	NA	Oklahoma County, OK	29	1.37
	8-Hour [2]	9	NA			0.8
NO_2 (ppb)	1-Hour [3]	100	NA	Oklahoma County, OK	29	54
	Annual	53	53			[10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Glenpool, OK	14	0.077
				Mannford, OK	13	0.078
				Oklahoma County, OK	29	0.079
PM_{10} ($\mu g/m^3$)	24-Hour [5]	150	150	Oklahoma County, OK	29	59
$PM_{2.5}$ ($\mu g/m^3$)	24-Hour [6]	35	35	Oklahoma County, OK	29	20
	Annual [7]	12.0	15.0	Oklahoma County, OK	29	10
Lead ($\mu g/m^3$)	3-Month [8]	0.15	0.15	Tulsa, OK	30	0.008

For table notes see Table 3.3-2.

3.3.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. The Region includes elevation changes associated with the Ouachita Mountains in the western part of the state as the Arkansas River meanders through the region, although the region is generally flat. The temperature is generally warmer in Arkansas than in Project regions to the west (NCDC 2014). Existing air quality monitoring for Region 4 is provided in Table 3.3-5. Though the Stilwell monitoring station shows ozone concentrations in excess of the NAAQS, the area is still formally classified as “attainment” for ozone and has yet to be redesignated as nonattainment for ozone.

Table 3.3-5:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 4

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data [9]
SO_2 (ppb)	1-Hour [1]	75	NA	Adair County, OK	12	7.3
	3-Hour	NA	500			[10]
CO (ppm)	1-Hour [2]	35	NA	Adair County, OK	12	0.63
	8-Hour [2]	9	NA			0.33
NO_2 (ppb)	1-Hour [3]	100	NA	Adair County, OK	12	16
	Annual	53	53			[10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Adair County, OK	12	0.077
				Sequoyah County, OK	6	0.073
PM_{10} ($\mu g/m^3$)	24-Hour [5]	150	150	Adair County, OK	12	87
$PM_{2.5}$ ($\mu g/m^3$)	24-Hour [6]	35	35	Adair County, OK	12	26
	Annual [7]	12.0	15.0	Adair County, OK	12	12
				Sequoyah County, OK	6	10.8
Lead ($\mu g/m^3$)	3-Month [8]	0.15	0.15	Pulaski County, AR	70	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. The region is generally flat and, like Region 4, the temperature is generally warmer in Arkansas than in Project regions further west (NCDC 2014). Existing air quality monitoring for Region 5 is provided in Table 3.3-6. The Little Rock monitoring station shows ozone concentrations in excess of the NAAQS, but the area has not been redesignated as "nonattainment" for ozone. In addition, Little Rock is a highly populated area, so criteria pollutant levels in the more remote Region 5 area (rural, with limited development) are likely to be lower than those measured in Little Rock and would be included in the nonattainment area for Little Rock.

Table 3.3-6:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 5

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data [9]
SO_2 (ppb)	1-Hour [1]	75	NA	Pulaski County, AR	40	10.3
	3-Hour	NA	500			[10]
CO (ppm)	1-Hour [2]	35	NA	Pulaski County, AR	40	1.8
	8-Hour [2]	9	NA			1.47
NO_2 (ppb)	1-Hour [3]	100	NA	Pulaski County, AR	40	51
	Annual	53	53			[10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Pulaski County, AR	40	0.078
				Newton County, AR	25	0.069
PM_{10} ($\mu g/m^3$)	24-Hour [5]	150	150	Pulaski County, AR	40	87

Table 3.3-6:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 5

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data [9]
$PM_{2.5}$ (µg/m³)	24-Hour [6]	35	35	Pulaski County, AR	40	26
	Annual [7]	12.0	15.0	Pulaski County, AR	40	12
Lead (µg/m³)	3-Month [8]	0.15	0.15	Pulaski County, AR	40	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and the Applicant Proposed Route and includes HVDC Alternative Routes 6-A through 6-D. The region is generally flat and, like Regions 4 and 5, the temperature is generally warmer in Arkansas than in Project regions further west (NCDC 2014). Existing air quality monitoring for Region 6 is provided in Table 3.3-7. Generally the monitoring stations are sited in populated areas and, as a result, criteria pollutant levels in Region 6 are assumed to be lower than those obtained by the monitoring stations. For example, the levels monitored at the Crittenden County, Arkansas, and Shelby County, Tennessee, stations are within the Memphis metropolitan area, which is nonattainment for criteria pollutant ozone. Region 6 is rural, located over 30 miles from the monitoring stations near Memphis; therefore, ozone emissions are thought to be lower than those provided in Table 3.3-7. The area is rural in nature with limited development.

Table 3.3-7:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 6

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data [9]
SO_2 (ppb)	1-Hour [1]	75	NA	Shelby County, TN	41	12
	3-Hour	NA	500			[10]
CO (ppm)	1-Hour [2]	35	NA	Shelby County, TN	41	2.3
	8-Hour [2]	9	NA			1.8
NO_2 (ppb)	1-Hour [3]	100	NA	Crittenden County, AR	25	46
	Annual	53	53			[10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Crittenden County, AR	25	0.080
				Shelby County, TN	41	0.079
PM_{10} (µg/m³)	24-Hour [5]	150	150	Shelby County, TN	41	41
$PM_{2.5}$ (µg/m³)	24-Hour [6]	35	35	Jackson County, AR	5	22
	Annual [7]	12.0	15.0	Jackson County, AR	5	10
Lead (µg/m³)	3-Month [8]	0.15	0.15	Pulaski County, AR	74	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D.The region is generally flat and shares meteorological conditions similar to the lowland areas of Arkansas (NCDC 2014). Much of the area is rural in nature with limited development, although the portions closest to the Memphis area are slightly more developed. Existing air quality monitoring for Region 7 is provided in Table 3.3-8. As stated in Section 3.3.4, Shelby County, Tennessee is designated "marginal nonattainment" with respect to the current ozone NAAQS, and is also a maintenance area with respect to the carbon monoxide NAAQS.

Table 3.3-8:
Criteria Pollutants, National Ambient Air Quality Standards and Existing Air Quality in Region 7

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Nearest Ambient Monitoring Site(s)	Distance to Nearest Monitoring Station (miles)	Most Recent Quality-Assured Data[9]
SO_2 (ppb)	1-Hour [1]	75	NA	Shelby County, TN	11	12
	3-Hour	NA	500			[10]
CO (ppm)	1-Hour [2]	35	NA	Shelby County, TN	11	2.3
	8-Hour [2]	9	NA			1.8
NO_2 (ppb)	1-Hour [3]	100	NA	Crittenden County, AR	18	46
	Annual	53	53			[10]
Ozone (ppm)	8-Hour [4]	0.075	0.075	Crittenden County, AR	18	0.080
				Shelby County, TN	11	0.079
PM_{10} (µg/m^3)	24-Hour [5]	150	150	Shelby County, TN	11	41
$PM_{2.5}$ (µg/m^3)	24-Hour [6]	35	35	Crittenden County, AR	18	23
				Shelby County, TN	11	23
	Annual [7]	12.0	15.0	Crittenden County, AR	18	11
				Shelby County, TN	11	10
Lead (µg/m^3)	3-Month [8]	0.15	0.15	Shelby County, TN	11	EPA AirData does not publish data

For table notes, see Table 3.3-2.

3.3.5.8 Connected Actions

3.3.5.8.1 Wind Energy Generation

The WDZs are all located within the Oklahoma Panhandle and the adjacent portions of Texas; therefore, the existing air quality is the same as that discussed in Section 3.3.5.1 for Region 1.

3.3.5.8.2 Optima Substation

The future Optima Substation would be located partially located within the Oklahoma AC Interconnection Siting Area. The existing air quality is the same as discussed in Section 3.3.5.1 for Region 1.

3.3.5.8.3 TVA Upgrades

As described above under Section 3.1.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.3.6 Impacts to Air Quality and Climate Change

Construction and operations and maintenance of the Project would involve sources of emissions of air pollutants and GHG emissions. This section is organized as follows:

- Section 3.3.6.1 summarizes the methodology used to quantify emissions.
- Section 3.3.6.2 describes the impacts associated with the Applicant Proposed Project.
- Section 3.3.6.3 describes the impacts associated with the DOE Alternatives.
- Section 3.3.6.4 describes the BMPs for emissions minimization.
- Sections 3.3.6.5 and 3.3.6.6 discuss unavoidable adverse impacts and irreversible and irretrievable commitments of resources, respectively.
- Sections 3.3.6.7 describe the relationship between local short-term uses and long-term productivity.
- Section 3.3.6.8 discusses impacts from connected actions, i.e., the wind farms proposed to be located on the western end of the line.
- Section 3.3.6.9 discusses impacts to air quality and climate change from the No Action Alternative.

3.3.6.1 Methodology

Emissions were estimated by calculating emissions factors (e.g., pounds per horsepower-hour of construction equipment activity, pounds per vehicle mile traveled, etc.) and multiplying by activity data provided by the Applicant (Clean Line 2013). The emission calculation methods, which represent currently accepted techniques, include the following:

- Use of equations in Sections 13.2.1, 13.2.2, and 13.2.3 of EPA's AP-42 publication to estimate fugitive dust emissions from construction (e.g., access roads, transmission line construction, and converter station construction) (EPA 2006b, 2011)
- Use of EPA's NONROAD2008a model (EPA 2009) to estimate emissions from construction equipment exhaust
- Use of factors/equations in Section 11.12 of EPA's AP-42 publication (EPA 2006a) to estimate emissions from portable concrete batch plant emissions during construction
- Construction soil disturbance and wind erosion resulting in fugitive dust emissions were calculated using methods described in WRAP Fugitive Dust Handbook (Countess Environmental 2006)
- Use of EPA's MOVES2010a model (EPA 2012) to estimate vehicle exhaust emissions for worker travel and movement of supplies during construction
- All mileages for worker trip and construction equipment trip calculations were provided by the Applicant

The Applicant provided information with respect to typical pieces of construction equipment (sizes, types, and hours of operation) and on-road vehicle traffic for (a) the construction of converter stations, (b) the construction of every 40 miles of AC collection system line (which were then scaled based on actual mileage), and (c) the construction of every 140 miles of HVDC transmission line (which were then scaled based on actual mileage). Emissions expected from the operations and maintenance phase of the Project would be negligible and would consist of emissions associated with periodic maintenance activities (e.g., worker vehicle trips). Displacement of fossil fuel power production via wind energy generation is an anticipated result from the connected wind energy developments that are anticipated to result from the Project. A qualitative assessment was undertaken to assess the benefits of these developments.

The Applicant has developed a comprehensive list of EPMs that would avoid or minimize impacts to air quality. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for release or mismanagement of hazardous constituents that could result in an impact on air quality are listed below:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- GE-25: Clean Line will turn off idling equipment when not in use.

3.3.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Applicant Proposed Project that would be common to the converter stations, AC interconnection, AC collection system, and HVDC Applicant Proposed Routes.

3.3.6.2.1 Converter Stations and AC Interconnection Siting Areas

Potential impacts from construction and operations and maintenance activities of the Project, including the converter stations and AC interconnections, are described below.

3.3.6.2.1.1 Construction Impacts

Air quality construction emissions would be temporary, lasting up to 42 months for the entire Project, but only 12 months for each converter station. Construction along AC interconnection lines would be shorter duration, with construction lasting for a matter of days to weeks. Although temporary, these emissions could impact sensitive areas nearby. The construction activities that would generate emissions include land clearing, ground excavation, and cut-and-fill operations (see Appendix F for more detail regarding equipment types). The intermittent and short-term emissions generated by these activities would include dust from soil disruption and combustion emissions from the construction equipment. Emissions associated with construction equipment include PM_{10}, $PM_{2.5}$, NO_x, CO, VOCs, SO_x, GHGs, and small amounts of air toxics. Because the emissions for mobile equipment, especially equipment used over wide distances to construct transmission lines, would occur in any one location for a matter of days or weeks, they would result in minor temporary impacts on air quality in the vicinity of ongoing construction activities. Additional information about emissions from construction equipment is included in the sections that follow. Detailed emissions calculations are provided in Appendix H.

3.3.6.2.1.1.1 Converter Stations

Emissions for constructing each of the converter stations are estimated to be approximately the same because the converter station sizes and construction processes are similar. Construction of the converter stations would be completed in three stages: site preparation, foundation installation, and erection of the station. Table 3.3-9 lists the total emissions (from all three stages) for each converter stations from non-road construction equipment exhaust; it does not include emissions from the use of portable concrete batch plants, which are addressed in Section 3.3.6.2.3.

Table 3.3-9:
Converter Station Non-Road Construction Equipment Emissions (Tons per Station)

CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
71.2	66.9	0.1	6.9	5.3	13,806.6

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions. CO_2e refers to emissions of the GHGs CO_2), CH_4, and N_2O, expressed as a weighted total where the weighting is based on the global warming potential of each gas. The global warming potential for CO_2 is 1 (by definition); for CH_4, it is 25, and for N_2O, it is 298.

On-road emissions would result from movement of construction equipment and worker vehicle trips/commutes to/from the construction areas. Because the exact routing and movement of equipment and workers is unknown for each of the converter stations, emissions estimates are based on the same assumptions for each converter station under consideration and were provided by the Applicant. Table 3.3-10 provides the total estimated on-road emissions associated with construction of each converter station.

Table 3.3-10:
Converter Station On-Road Emissions (Tons per Station)

Vehicle/Equipment[1]	CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
Construction Equipment Transportation	7.3	5.2	0.0	0.6	0.2/0.2	2,410
Worker Trips/Commutes	7.2	0.9	0.0	0.1	0.0/0.0	738

1 Emissions factors obtained from the EPA's MOVES2010b model (EPA 2012). $PM_{10}/PM_{2.5}$ emissions include brake and tire wear.

Fugitive dust emissions would be generated by construction of each converter station. These emissions would result from both construction and commuter vehicles traveling on area paved and unpaved roadways. Additional fugitive dust emissions would result from construction ground disturbance and wind erosion during construction of each 45- to 60-acre converter station site. Table 3.3-11 provides the estimated fugitive dust calculations for each converter station (based on an assumption of 50 acres per site). Tire and brake wear are accounted for in on-road PM_{10} and $PM_{2.5}$ emissions.

Table 3.3-11:
Converter Station Fugitive Dust Emissions (Tons per Station)

Roadway Type[1]	PM_{10}	$PM_{2.5}$
Paved Roads	9.2	2.3
Unpaved Roads	15.0	1.5
Ground Disturbance and Wind Erosion	33.0	3.3

1 Emissions factors obtained via Project-anticipated vehicle miles traveled for converter stations and by implementing the guidelines in AP 42 Chapter 13 Section 13.2.1 (EPA 2006b) and AP 42 Chapter 13 Section 13.2.2 (EPA 2011). Fugitive dust calculations do not include tire and brake wear. Ground disturbance and wind erosion calculations made using WRAP Fugitive Dust Handbook guidance.

The Tennessee converter station would be located in Shelby County or Tipton County, Tennessee. Shelby County is part of a three-county marginal nonattainment area for ozone (i.e., Crittenden County, Arkansas, Shelby County, Tennessee, and a portion of DeSoto County, Mississippi) and is also a CO maintenance area. If it is determined that in any calendar year emissions of either VOC or NO_x (i.e., ozone precursors) from all Project construction activities within the ozone nonattainment area exceed the General Conformity Rule *de minimis* levels of 100 tons per year (TPY) for NO_X or VOCs, or emissions of CO from Project construction activities within Shelby County exceed the General Conformity Rule threshold of 100 TPY, federal agencies are required to make determinations of general conformity with the State Implementation Plans (SIPs) in accordance with the requirements in 40 CFR Part 93, Subpart B. Construction of the converter stations could overlap with construction of the Applicant Proposed Route in Shelby County, Tennessee. Therefore, of these three nonattainment pollutants, as shown in Tables 3.3-9 and 3.3-10, CO is the pollutant emitted in the highest quantity by construction equipment at the converter station and NO_x is the pollutant emitted in the highest quantity by construction equipment for the HVDC transmission line (as described in Section 3.3.6.2.4). However, only 5 miles of Applicant Proposed Route would be constructed in Shelby County, TN. Therefore total emissions from construction of the Applicant Proposed converter station and HVDC transmission line within Shelby County, Tennessee, would be 83 tons of NO_x. These emissions estimates would be even lower as the Applicant intends to distribute these activities over an estimated 2-year construction period, such that emissions in each year would be even further below *de minimis* level of 100 TPY; therefore, a general conformity determination is not required.

3.3.6.2.1.2 Operations and Maintenance Impacts

During the operations and maintenance phase of the Project, the converter stations and AC interconnection would emit negligible air pollutants. Standard operation of the converter stations and AC interconnection would not emit air pollutants, but maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment. Converter station gas insulated switchgear may contain sulfur hexafluoride, a potent GHG. However, with BMPs implemented sulfur hexafluoride emissions would be negligible to nonexistent. As a result, levels below the *de minimis* thresholds are anticipated from operation or maintenance of the converter stations and AC interconnection.

3.3.6.2.1.3 Decommissioning Impacts

Decommissioning of the Project may occur at the end of its functional usefulness. Although details of decommissioning cannot be predicted, it is generally estimated that decommissioning emissions would be similar to (or less than) those associated with construction. The Applicant would create a Decommissioning Plan before decommissioning the Project.

3.3.6.2.2 AC Collection System

Construction of the proposed AC collection system, located in Region 1, would result in air quality and GHG emissions. Construction of AC collection system would be completed in discrete stages: ROW clearing, access roads and pad construction, foundation installation, structure lacing, structure setting, wire stringing, and restoration in addition to other support of these operations such as compliance monitoring and refueling. Because the exact routing and movement of equipment and workers is unknown for each of the AC collection system route alternatives, the analyses in this section are based on the same assumptions for each alternative under consideration. Total emissions associated with construction of the AC collection system route alternatives were calculated on a combined basis for all construction phases. Table 3.3-12 lists the estimated non-road emissions of criteria pollutants and CO_2e

that would be generated by each 40-mile segment of AC transmission line construction—excluding emissions from concrete batch plants (which are addressed in Section 3.3.6.2.3. Emissions would not be localized, taking place across 40-mile segments, and therefore are not anticipated to cause or significantly contribute to a violation of an applicable ambient air quality standard or contribute substantially to an existing or projected air quality violation.

Table 3.3-12:
Non-Road Construction Equipment Emissions (Tons) per 40-Mile Segment of AC Collection System

	CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
Non-Road emissions	17.7	39.1	0.1	3.7	2.5	7,598.1

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions.

Total emissions for each AC collection system route were calculated by taking the distance of each AC transmission line, dividing by 40 miles, and multiplying by the values in Table 3.3-12. Table 3.3-13 provides the results of this analysis (excluding those associated with portable concrete batch plants) and shows that the highest emissions would be associated with AC Collection System Route NW-2 (the longest) and the lowest emissions would be associated with AC Collection System Route SW-1 (the shortest).

Table 3.3-13:
AC Collection System Routes Non-Road Construction Equipment Emissions (Tons) by Route

AC Collection	Length (miles)	Pollutant Emissions (tons)					
		CO	NOx	SO2	VOC	$PM_{10}/PM_{2.5}$	CO2e
E-1	28.9	12.4	27.4	0.0	2.6	1.8	5318.7
E-2	39.8	17.7	39.1	0.1	3.7	2.5	7598.1
E-3	40.0	17.7	39.1	0.1	3.7	2.5	7598.1
NE-1	30.1	14.2	31.3	0.0	3.0	2.0	6078.5
NE-2	26.3	12.4	27.4	0.0	2.6	1.8	5318.7
NW-1	51.9	23.0	50.9	0.1	4.8	3.3	9877.6
NW-2	56.0	24.8	54.8	0.1	5.2	3.5	10637.4
SE-1	40.3	17.7	39.1	0.1	3.7	2.5	7598.1
SE-2	13.4	5.3	11.7	0.0	1.1	0.8	2279.4
SE-3	49.1	21.2	47.0	0.1	4.4	3.0	9117.8
SW-1	13.4	5.3	11.7	0.0	1.1	0.8	2279.4
SW-2	37.0	15.9	35.2	0.1	3.3	2.3	6838.3
W-1	20.7	8.9	19.6	0.0	1.9	1.3	3799.1

On-road emissions would result from movement of construction equipment and worker vehicle trips/commutes to/from the construction areas (including those associated with transporting portable concrete batch plants). Table 3.3-14 provides the estimated on-road emissions associated with construction of each 40-mile segment of AC transmission line (including those associated with transporting portable concrete batch plants); these are substantially lower than the non-road emissions identified in Table 3.3-12.

Table 3.3-14:
AC Collection System Routes On-Road Emissions (Tons) per 40-Mile Segment

Vehicle/Equipment	CO	NO_x	SO_2	VOC	$PM_{10}/PM_{2.5}$	CO_2e
Construction Equipment Transport	2.4	5.4	0.0	0.4	0.2/0. 2	2,159
Worker Trips/Commutes	5.0	0.6	0.0	0.1	0.0/0.0	542

Notes: Emissions factors obtained from the EPA's MOVES2010b model (EPA 2012). $PM_{10}/PM_{2.5}$ emissions include brake and tire wear.

Fugitive dust emissions would result from construction of the AC transmission lines. These emissions would result from both construction and commuter vehicles traveling on area paved and unpaved roadways. Table 3.3-15 provides the fugitive dust calculations for a representative 1-mile and 40-mile segment of AC line construction (excluding those associated with use of concrete batch plants), respectively. Construction of the AC transmission line would be localized, so these representative segment lengths of transmission line ROW construction provide a range for comparative purposes. In reality, construction of any given segment of AC transmission line would generally result in ground disturbance along the ROW between 5 and 10 miles in length. Although the values are relatively high, it should be recognized that it is widely known that there are several technical issues associated with the quantification of fugitive dust and they may overstate air quality impacts. For example, although regional emissions inventories typically show fugitive dust as the predominant source of PM emissions, chemical analyses of ambient PM concentrations shows that fugitive dust is a minor contributor to ambient PM concentrations, perhaps because a large fraction of fugitive dust from roadways is not suspendable and/or transportable over long distances (Watson and Chow 2000; Countess Environmental 2001). As a result, EPA transportation conformity regulations allow re-entrained road dust and construction-related fugitive dust to be excluded from emissions evaluations unless they have been identified as significant contributors to ambient PM concentrations.[1]

Table 3.3-15:
AC Collection System Route Fugitive Dust Emissions (Tons) per 1-mile and 40-Mile Segments

Representative Segment	Fugitive Dust Emission Source	PM_{10}	$PM_{2.5}$
1-Mile of AC Collection System Route	Paved Roads	0.1	0.0
	Unpaved Roads	1.4	0.1
	Ground Disturbance and Wind Erosion	1.3	0.1
40-Mile of AC Collection System Route	Paved Roads	5.1	1.3
	Unpaved Roads	54.0	5.4
	Ground Disturbance and Wind Erosion	640.0	64.0

Note: Emissions factors obtained via Project anticipated vehicle miles traveled for converter stations and by implementing the guidelines in AP 42 Chapter 13 Section 13.2.1 (EPA 2011) and AP 42 Chapter 13 Section 13.2.2 (EPA 2006b). Fugitive dust calculations do not include tire and brake wear. Ground disturbance and wind erosion calculations made using WRAP Fugitive Dust Handbook guidance. Forty-mile segment emissions were estimated for 12-month period and 1-mile segment emissions were estimated for 1-month duration.

Fugitive dust emissions, including wind erosion and ground disturbance, associated with construction of each of the AC collection system routes were calculated by scaling the 40-mile emissions values in Table 3.3-15 to the distance of each AC line. Table 3.3-16 provides the results of this analysis and shows that the highest fugitive dust emissions would be associated with AC Collection System Route SE-3 and the lowest would be associated with AC Collection System Route SW-1. Brake and tire wear are accounted for in on-road emissions.

[1] 40 CFR Part 93 Subpart A, §93.119(f)(8), §93.122(e), §93.122(f).

Table 3.3-16:
AC Collection System Routes Fugitive Dust Emissions (Tons)

Route	Length (Miles)	PM_{10}	$PM_{2.5}$
E-1	28.9	516.3	52.3
E-2	39.8	702.1	71.0
E-3	40.0	704.2	71.2
NE-1	30.1	531.7	53.8
NE-2	26.3	467.3	47.3
NW-1	51.9	905.3	91.4
NW-2	56.0	974.8	98.4
SE-1	40.3	705.9	71.3
SE-2	13.4	249.6	25.4
SE-3	49.1	855.3	86.4
SW-1	13.4	249.7	25.4
SW-2	37.0	651.4	65.9
W-1	20.7	376.7	38.2

3.3.6.2.2.1 Operations and Maintenance Impacts

Operations and maintenance of the AC collection system routes would result in negligible amounts of air pollutants. Standard operation of the AC transmission lines would not emit air pollutants, but maintenance activities would emit small amounts of pollutants associated with combustion of fossil fuels for worker vehicles and equipment. As a result, inconsequential impacts are anticipated from operations or maintenance of the AC collection system routes.

3.3.6.2.2.2 Decommissioning Impacts

Decommissioning of the Project—i.e., the partial and/or total removal of built structures—may occur at the end of its functional usefulness. Although details of decommissioning cannot be predicted, it is generally estimated that emissions associated with decommissioning would be similar to (or less than) those associated with construction (in part because tearing things down involves less effort than erecting them, and in part because it is assumed that decommissioning would occur many years in the future, when the engines used are likely to be lower-emitting). The Applicant would create a Decommissioning Plan before decommissioning the Project.

3.3.6.2.3 Portable Concrete Batch Plants

Access to concrete would be required at approximate 60-mile intervals along the transmission line corridor. The Applicant would use local concrete plants where possible. Construction of the Project may require the use of portable concrete batch plants. The Applicant has indicated where the haul distance exceeds 25 to 30 miles the use of portable concrete batch plants is anticipated. The construction of concrete batch plants would result in air quality and GHG emissions. Table 3.3-17 lists the estimated non-road emissions of criteria pollutants and CO_2e for each portable concrete batch plant. At this time it is unknown where each portable concrete batch plant would be required and located; however, the emission levels associated with construction of each batch plant would be negligible relative to the emissions identified in Sections 3.3.6.2.1 and 3.3.6.2.2.

Table 3.3-17:
Portable Concrete Batch Plant Non-Road Construction Equipment Emissions (Tons)

CO	NO_x	SO_2	VOC	PM_{10}/PM2.5	CO_2e
0.3	0.8	0.0	0.1	0.1	205

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions.

Fugitive dust emissions would result from construction of the portable concrete batch plants. These emissions would result from both construction and commuter vehicles traveling on paved and unpaved roadways and are predicted to be 0.67 ton of PM_{10} and 0.07 tons of $PM_{2.5}$. These emissions impacts would be temporary and low level, so they would be considered minor. Fugitive dust calculations do not include tire and brake wear.

Operation of each portable concrete batch plant during construction would result in emissions of particulate matter (PM_{10} and $PM_{2.5}$). The Applicant has identified that fugitive dust from (a) unloading cement and cement supplement to silos, (b) mixer loading, and (c) truck loading would all be controlled (e.g., by fabric filter for silo loading, and by water sprays, enclosures, hoods, curtains, shrouds, movable and telescoping chutes, central duct collection systems, etc.), and that the total throughput for all of the portable concrete batch plants would be approximately 3,030 tons of cement and 450 tons of cement supplement (Clean Line 2013). Like other emissions associated with construction, because they would be temporary and would result in low emissions (0.2 ton of PM_{10} and 0.02 ton of $PM_{2.5}$), impacts are expected to be minor.

On-road emissions estimates for the portable concrete batch plants (excluding fugitive dust) are included in the respective transmission line analysis (e.g., AC or HVDC).

3.3.6.2.4 HVDC Applicant Proposed Route

Air quality emissions from construction and operation would potentially result from construction of the HVDC Applicant Proposed Route.

3.3.6.2.4.1 Construction Impacts

Construction of the Applicant Proposed Route would result in criteria air pollutant and GHG emissions. Construction of the proposed HVDC transmission line would be completed in discrete stages: ROW clearing; access roads and pad construction; foundation installation; structure lacing; structure setting; wire stringing; restoration; in addition to other support of these operations such as compliance monitoring and refueling. Because the exact routing and movement of equipment and workers is unknown by region, emissions would be based on the same assumptions for each of the regions. Total emissions for each region were considered regardless of construction stage or phase. Table 3.3-18 lists the estimated non-road emissions that would be generated by each 140-mile segment of HVDC transmission line (see Section 2.1.4) construction (excluding concrete batch plant emissions). Construction of the transmission line would occur in one continuous operation, so emissions would be localized in and have been assumed to take place within 140-mile segments along the HVDC transmission line. Because the emissions would be temporary and are for mobile equipment spread out over wide distances, they would result in minor temporary impacts on air quality in the vicinity of construction activities.

Table 3.3-18:
Non-Road Construction Equipment Emissions (Tons) per 140-Mile Segment of HVDC Line
(compared to 140-mile segment of Interstate 40 for perspective)

	CO	NO_x	SO_2	VOC	PM_{10}/PM2.5	CO_2e
Construction Equipment Emissions	61.2	134.4	0.2	12.8	8.7	26,031

Note: Emissions factors obtained from the EPA's NONROAD2008a model (EPA 2009) and $PM_{2.5}$ emissions are conservatively estimated at being equal to PM_{10} emissions; Interstate 40 is assumed to have traffic volume of 20,000 vehicles per day

Total estimated emissions for the Applicant Proposed Route in each region were derived by scaling the emissions for a 140-mile segment to the length of the actual route (in miles). Table 3.3-19 provides the results of this analysis.

Table 3.3-19:
HVDC Line Alternatives Non-Road Construction Equipment Emissions (Tons) by Alternative

		Pollutant Emissions (Tons)					
Route	Length (miles)	CO	NO_x	SO_2	VOC	PM_{10}/$PM_{2.5}$	CO_2e
APR Region 1	115.46	50.5	110.8	0.2	10.5	7.2	21,468
APR Region 2	105.97	46.4	101.7	0.2	9.7	6.6	19,704
APR Region 3	161.69	70.7	155.2	0.2	14.8	10.1	30,064
APR Region 4	126.28	55.2	121.2	0.2	11.5	7.9	23,480
APR Region 5	112.8	49.3	108.2	0.2	10.3	7.0	20,974
APR Region 6	54.36	23.8	52.2	0.1	5.0	3.4	10,108
APR Region 7	42.83	18.7	41.1	0.1	3.9	2.7	7,964

Estimated on-road emissions would result from movement of construction equipment and worker vehicle trips/commutes to/from the construction areas. Table 3.3-20 provides the on-road emissions associated with construction of each 140-mile segment of the Applicant Proposed Route.

Table 3.3-20:
On-Road Construction Equipment Emissions (Tons) per 140-Mile Segment of HVDC Line

Vehicle/Equipment	CO	NO_x	SO_2	VOC	PM_{10}/$PM_{2.5}$	CO_2e
Construction Equipment	8.4	18.9	0.1	1.6	0.7/0.7	7,557
Worker Trips/Commutes	18.4	2.2	0.0	0.4	0.1/0.0	1,896

Note: Emissions factors obtained from the EPA's MOVES2010b model (EPA 2012). PM_{10}/$PM_{2.5}$ emissions include brake and tire wear. See

Fugitive dust emissions would result from construction of the Applicant Proposed Route. These emissions would result from both construction and commuter vehicles traveling on local paved and unpaved roadways. Table 3.3-21 provides the estimated fugitive dust calculations for a representative 1-mile and 140-mile segment of HVDC transmission line construction, respectively. Construction of the HVDC transmission line would be localized, so these representative segment lengths of transmission line ROW construction provide a range for comparative purposes. In reality, construction of any given segment of HVDC transmission line would generally result in ground disturbance along the ROW between five and 10 miles in length.

Table 3.3-21:
Fugitive Dust Emissions (Tons) per 140-Mile Segment of HVDC Line

Representative Segment	Fugitive Dust Emission Source	PM_{10}	$PM_{2.5}$
1-Mile of AC Collection System Route	Paved Roads	0.1	0.0
	Unpaved Roads	1.4	0.1
	Ground Disturbance and Wind Erosion	1.3	0.1
40-Mile of AC Collection System Route	Paved Roads	18.1	4.4
	Unpaved Roads	189.1	18.9
	Ground Disturbance and Wind Erosion	2,240.0	224.0

Note: Emissions factors obtained via Project anticipated vehicle miles traveled for converter stations and by implementing the guidelines in AP 42 Chapter 13 Section 13.2.1 (EPA 2011) and AP-42 Chapter 13 Section 13.2.2 (EPA 2006b). Fugitive dust calculations do not include tire and brake wear. Ground disturbance and wind erosion calculations made using WRAP Fugitive Dust Handbook guidance. 140-mile segment emissions estimated for 12 month period, 1-mile segment emissions estimated for 1-month duration.

Fugitive dust emissions for each region of the Applicant Proposed Route were calculated by taking the distance of each HVDC transmission line, dividing by 140 miles, and multiplying by the emissions shown in Table 3.3-21. Table 3.3-22 provides the results of this analysis. Tire and brake wear are accounted for in on-road emissions.

Table 3.3-22:
HVDC Line Alternatives Fugitive Dust Emissions (Tons)

Route	Length (miles)	PM_{10}	$PM_{2.5}$
APR Region 1	115.5	2,049.3	207.3
APR Region 2	106.0	2,026.4	204.9
APR Region 3	161.7	2,833.4	286.2
APR Region 4	126.3	2,232.3	225.7
APR Region 5	112.8	2,003.4	202.7
APR Region 6	54.4	1,007.6	196.6
APR Region 7	42.8	809.7	82.5

3.3.6.2.4.2 Operations and Maintenance Impacts

Operations and maintenance of the Applicant Proposed Route would emit negligible amounts of air pollutants. Standard operation of the transmission lines would not emit air pollutants, but maintenance activities would result in very low level temporary emissions of pollutants associated with combustion of fossil fuels for worker vehicles and equipment. As a result, negligible impacts would be anticipated from construction or operations and maintenance of the Applicant Proposed Route.

3.3.6.2.4.3 Decommissioning Impacts

Decommissioning of the Project may occur at the end of its functional usefulness. Although details of decommissioning cannot be predicted, it is generally estimated that decommissioning emissions would be similar to (or less than) those associated with construction. The Applicant would create a Decommissioning Plan before decommissioning the Project.

3.3.6.3 Impacts Associated with the DOE Alternatives

Air quality emissions were calculated for the DOE Alternatives.

3.3.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

Predicted air quality emissions from the construction, operations and maintenance, and decommissioning of the Arkansas converter station would be approximately the same as those described in Section 3.3.6.2.1 for each of the Applicant Proposed Project converter stations because this converter station would be of similar size and all would be constructed following the same process.

3.3.6.3.2 HVDC Alternative Routes

Construction and operational impacts from the HVDC alternative routes would be similar to those of the Applicant Proposed Route, the only variation being the amount of air quality emissions based on the respective length of each HVDC alternative route. Operationally, air quality emissions for each HVDC alternative route would be the same as those described in Section 3.3.6.2.4 for the Applicant Proposed Route.

3.3.6.3.2.1 Construction Impacts

The HVDC alternative routes would use the same construction approaches described in Section 3.3.6.2.4. Air quality emissions would vary with the length of each HVDC alternative route. Table 3.3-23 provides the air quality emissions for each HVDC alternative route and Table 3.3-24 provides fugitive dust emissions for each alternative. Brake and tire wear are included in on-road emissions.

Table 3.3-23:
Non-Road Construction Equipment Emissions (Tons)—HVDC Alternative Routes

Route	Length (miles)	Pollutant Emissions (tons)					
		CO	NO_x	SO_2	VOC	PM_{10}/PM2.5	CO_2e
Region 1							
AR 1-A	123.0	53.8	118.0	0.2	11.2	7.7	22,864.7
AR 1-B	51.9	22.7	49.8	0.1	4.7	3.2	9,642.7
AR 1-C	52.0	22.8	49.9	0.1	4.8	3.2	9,674.3
AR 1-D	33.5	14.6	32.1	0.1	3.1	2.1	6,219.6
Region 2							
AR 2-A	57.2	25.0	54.9	0.1	5.2	3.6	10,628.2
AR 2-B	29.8	13.0	28.5	0.0	2.7	1.9	5,531.6
Region 3							
AR 3-A	37.6	16.5	36.1	0.1	3.4	2.3	6,993.1
AR 3-B	47.7	20.9	45.8	0.1	4.4	3.0	8,874.8
AR 3-C	121.6	53.2	116.7	0.2	11.1	7.6	22,615.6
AR 3-D	39.3	17.2	37.7	0.1	3.6	2.5	7,312.9
AR 3-E	8.5	3.7	8.1	0.0	0.8	0.5	1,578.6
Region 4							
AR 4-A	58.4	25.5	56.0	0.1	5.3	3.6	10,858.8
AR 4-B	78.6	34.4	75.4	0.1	7.2	4.9	14,614.7

Table 3.3-23:
Non-Road Construction Equipment Emissions (Tons)—HVDC Alternative Routes

Route	Length (miles)	Pollutant Emissions (tons)					
		CO	NO_x	SO_2	VOC	PM_{10}/PM2.5	CO_2e
AR 4-C	3.4	1.5	3.2	0.0	0.3	0.2	626.6
AR 4-D	25.3	11.1	24.3	0.0	2.3	1.6	4,707.9
AR 4-E	36.7	16.1	35.2	0.1	3.4	2.3	6,827.6
Region 5							
AR 5-A	12.6	5.5	12.1	0.0	1.2	0.8	2,346.5
AR 5-B	71.0	31.0	68.1	0.1	6.5	4.4	13,194.1
AR 5-C	9.2	4.0	8.8	0.0	0.8	0.6	1,708.8
AR 5-D	21.7	9.5	20.8	0.0	2.0	1.4	4,036.7
AR 5-E	36.3	15.9	34.8	0.1	3.3	2.3	6,742.1
AR 5-F	22.3	9.8	21.4	0.0	2.0	1.4	4,152.0
Region 6							
AR 6-A	16.2	7.1	15.5	0.0	1.5	1.0	3,008.5
AR 6-B	14.1	6.2	13.5	0.0	1.3	0.9	2,623.6
AR 6-C	23.1	10.1	22.2	0.0	2.1	1.4	4,298.9
AR 6-D	9.2	4.0	8.8	0.0	0.8	0.6	1,701.3
Region 7							
AR 7-A	43.2	18.9	41.5	0.1	3.9	2.7	8,039.9
AR 7-B	8.6	3.8	8.3	0.0	0.8	0.5	1,600.9
AR 7-C	23.8	10.4	22.9	0.0	2.2	1.5	4,430.9
AR 7-D	6.5	2.9	6.3	0.0	0.6	0.4	1,216.0

Table 3.3-24:
HVDC Alternatives Fugitive Dust Emissions (Tons)

Route	Length (miles)	PM_{10}	$PM_{2.5}$
Region 1			
AR 1-A	123.0	2,173.5	208.0
AR 1-B	51.9	963.4	14.2
AR 1-C	52.0	966.3	14.3
AR 1-D	33.5	650.1	12.3
Region 2			
AR 2-A	57.2	1,052.7	199.8
AR 2-B	29.8	626.3	12.0
Region 3			
AR 3-A	37.6	719.8	73.4
AR 3-B	47.7	892.4	90.8
AR 3-C	121.6	2,148.8	217.3
AR 3-D	39.3	747.6	76.2
AR 3-E	8.5	223.7	23.5

Table 3.3-24:
HVDC Alternatives Fugitive Dust Emissions (Tons)

Route	Length (miles)	PM_{10}	$PM_{2.5}$
Region 4			
AR 4-A	58.4	1,073.5	218.7
AR 4-B	78.6	1,417.9	17.0
AR 4-C	3.4	136.3	9.2
AR 4-D	25.3	509.6	11.5
AR 4-E	36.7	704.6	12.7
Region 5			
AR 5-A	12.6	293.9	30.5
AR 5-B	71.0	1,287.1	130.5
AR 5-C	9.2	235.4	24.7
AR 5-D	21.7	448.2	46.1
AR 5-E	36.3	696.1	71.0
AR 5-F	22.3	458.5	47.1
Region 6			
AR 6-A	16.2	354.7	36.7
AR 6-B	14.1	318.5	33.0
AR 6-C	23.1	473.2	48.6
AR 6-D	9.2	234.7	24.6
Region 7			
AR 7-A	43.2	812.7	82.8
AR 7-B	8.6	225.1	23.6
AR 7-C	23.8	482.4	49.5
AR 7-D	6.5	190.0	20.1

3.3.6.3.2.2 Operations and Maintenance Impacts

Operations and maintenance of any of the HVDC alternative routes would emit negligible air pollutants similar to those described in Section 3.3.6.2.4 for the Applicant Proposed Route.

3.3.6.3.2.3 Decommissioning Impacts

Decommissioning of the Project would be the same as those described in Section 3.3.6.2.4 for the Applicant Proposed Route.

3.3.6.4 Best Management Practices

In addition to the EPMs developed by the Applicant the following BMP has been identified to control potential emissions of sulfur hexafluoride.

The quantity of sulfur hexafluoride emissions from maintenance activities (and potential leaks in equipment) would be mitigated through the use of hermetically sealed equipment, leak detection programs, and sulfur hexafluoride recycling programs.

3.3.6.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to air quality are anticipated to result from the Project.

3.3.6.6 Irreversible and Irretrievable Commitment of Resources

No irreversible and irretrievable commitments of air quality resources are anticipated to result from the Project.

3.3.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Emissions from construction of the Project are not predicted to impact sensitive receptors and also would not impact long-term productivity. While over the short-term emissions from construction would be higher in localized areas—because the Project provides for development of non-fossil fuel energy sources over the long term—air quality would be improved in comparison to not building the Project.

3.3.6.8 Impacts from Connected Actions

3.3.6.8.1 Wind Energy Generation

The impacts from the wind energy generation facilities that would interconnect to the Project as a result of the Project being built were qualitatively assessed because precise wind energy developments have not been identified that may result after the Project is constructed. The anticipated wind energy developments are all located within the Region 1 Oklahoma Panhandle and the adjacent portions of Texas. Although site-specific layouts of wind energy generation facilities in the wind energy development zones identified in Region 1 have yet to be designed, information regarding air emissions impacts from these potential wind energy generation facilities has been provided by the Applicant (Clean Line 2014). Emissions from construction activities were calculated based on techniques similar to those that were used to analyze impacts from the Applicant Proposed Project and DOE Alternatives. The potential impacts would be more than compensated for by reductions in emissions associated with the fact that wind energy projects generate nominal emissions, such as those from maintenance activities, and the power generated by wind energy would displace power that could otherwise be generated from fuel combustion. The benefit to air quality of these wind energy developments via displacing fossil fuel energy sources would outweigh the temporary construction air quality impacts. Section 3.3.6.8.1.2 provides qualitative analysis of the air quality emissions that may be expected from wind energy developments.

3.3.6.8.1.1 Construction Impacts

Construction of wind farms would result in criteria air pollutant and GHG emissions via engines burning fossil fuels. Fugitive dust would also result from construction of wind farms. Construction equipment emissions would be intermittent and generated in relatively small areas confined to the areas of wind farm construction. Construction planners estimate that the erection of wind farms requires roughly 150,000 gallons of fuel (approximately 85 percent diesel, 15 percent gasoline) per 100MW of capacity constructed (Repholz 2014). The GHG emissions associated with construction of 4,000–4,550MW of generating capacity is therefore approximately 66,000 to 75,000 tons CO_2e;[2] the corresponding emissions of NO_x, the most prevalent criteria pollutant in the exhaust of construction equipment,

[2] This calculation is based on fuel heating values and GHG emission factors in 40 CFR Part 98, Subpart C.

would depend on the exact mix of equipment but would be in the neighborhood of 300 to 600 tons.[3] These construction emissions would be temporary, and are not expected to contribute to substantially increased air pollutant concentrations.

Dust suppressants would be implemented to reduce fugitive dust emissions during construction of the wind farms. Typically, impacts related to fugitive dusts during construction of wind farms are reduced through the use of dust palliatives and through micro-siting the turbines and related components in such a way to minimize or eliminate potential temporary impacts.

3.3.6.8.1.2 Operations and Maintenance Impacts

Operational impacts to air quality associated with the wind farms are expected to be beneficial, because operations and maintenance of wind farms would result in negligible emissions (Clean Line 2014), whereas much of the electricity generated today is produced with fossil fuels such as coal or natural gas. The Applicant used a commercially available simulation model (PROMOD version 10.1; Ventyx 2014) to determine a best estimate of which power sources would be displaced and what the corresponding emissions reduction would be. The Applicant used the Ventyx East NERC version 9.4 root database and updated the database to reflect expected 2018 market conditions as of May/June 2013, when the simulation work began. The model updates included but were not limited to transmission upgrades to reflect ISO transmission plans, market membership changes (e.g., Entergy joining MISO), then-current natural gas forecast, and recently announced coal plant retirements. The model provided a best estimate of displaced emissions as follows: approximately 0.00058 pounds NO_x/megawatt hours (MWh), 0.0017 pounds SO_x/MWh, 0.707 pounds CO_2/MWh, and 0.0000114 pounds mercury/MWh. Using these displaced emissions rates with the range of megawatts of anticipated power production from wind energy as identified in Section 2.5.1, calculations of displaced emissions were calculated as follows:

- NO_x, 9,800 to 11,100 TPY
- SO_x 29,000 to 33,000 TPY
- CO_2e 12 to 14 million TPY
- Mercury 0.1 TPY (approximate)

These reductions in emissions occur each year, and even 1 year of emissions reduction far exceeds the combined emissions increases associated with the construction of the Project and the wind farms. Although the emissions reduction from this single project is small relative to the 7,249 million tons CO_2e (6,576 million metric tonnes) emitted by anthropogenic sources in the United States in 2009, the electric power generation sector contributes approximately 40 percent of those emissions (EIA 2011) and the implementation of lower-GHG electricity generation is therefore an important component of achieving significant GHG emissions reductions both nationally and globally. Currently, there is no methodology that would allow DOE to estimate the specific impacts (if any) this increment of climate change would produce in the vicinity of the facility or elsewhere.

[3] The lower end of this range is based on an average NO_x emissions rate of approximately 0.74 pound per one million British thermal units (mmBtu) of heat input for 4,000MW of generation; the higher end is based on an average NOx emissions rate of approximately 1.3 lb/mmBtu for 4,550MW of generation.

3.3.6.8.2 Optima Substation

Operationally the Substation would not result in air quality impacts. Construction emissions would be similar to those for the Project or DOE alternative converter stations and therefore would not result in exceedance of the NAAQS. Therefore, no impacts to air quality are anticipated from construction of the future Optima Substation.

3.3.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

Upgrades required to interconnect into the TVA transmission grid could involve potential impacts to air quality for the new transmission line, upgrades to existing lines, and modifications to substations. These impacts would be similar to those described in detail in Section 3.3.6 for the Project. For upgrades to or new transmission lines and modifications to substations air quality and climate change impacts of concern would be associated primarily with construction and include fugitive dust emissions, exhaust from construction equipment and vehicles, and portable concrete batch plant emissions. Air emissions during construction would be intermittent and short term, with anticipated minor temporary impacts on air quality near the construction activities. The TVA upgrades would be anticipated to result in negligible air quality impacts because they would be temporary and not contribute to air quality impacts on a continued basis.

If the new or upgraded transmission lines or substation modifications occur in areas classified as nonattainment with respect to any of the air quality standards, they would be subject to provisions of regulatory requirements.

The TVA upgrades would be expected to result in negligible contributions of GHGs during short-term construction activities, similar to the Project.

3.3.6.9 Impacts from the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed or operated, so no emissions would be associated with any activities related to the Project and no emissions reduction associated with the displacement of fossil-fueled power generation by the wind generation associated with the Project.

Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

3.4 Electrical Environment

The Project includes the following electrical facilities associated with the electrical environment:

- Applicant Proposed Project:
  - A ±600kV HVDC overhead electric transmission line with the capability to deliver approximately 3,500MW (utilizing two proposed line design configurations) along a preferred route
  - Two AC/DC converter stations (one in Oklahoma and another in Tennessee)
  - One double circuit AC transmission line of up to 345kV to connect the Oklahoma converter station
  - Two 500kV AC transmission lines to connect the Tennessee converter station
  - Four to six AC transmission lines of up to 345kV for the AC Collection System in Oklahoma and Texas
- DOE Alternatives:
  - A ±600kV HVDC overhead electric transmission line utilizing alternative routes
  - One AC/DC converter station (in Arkansas)
  - One 500kV AC transmission line to connect the Arkansas converter station (if constructed)

Detailed information regarding the transmission line configurations and convertor stations can be referenced in Chapter 2. The electrical environment evaluation involves analysis of the following electrical effects:

- DC electric fields
- AC electric fields
- DC magnetic fields
- AC magnetic fields
- Audible noise
- Radio and television noise interference
- Ozone and air ions

The following sections describe each of these electrical effects and how they relate to electrical facilities such as transmission lines.

3.4.1 Electric Fields

Voltage (electrical pressure) on an object causes an electric field. Any object with an electric charge on it has a voltage at its surface, caused by the accumulation of more electrons on that surface as compared with another object or surface. The voltage effect is not limited to the surface of the object but exists in the space surrounding the object in diminishing intensity. Electric fields can exert a force on other electric charges at a distance. The change in voltage over distance is known as the electric field. The units describing an electric field are volts per meter (V/m) or thousands of volts per meter (kilovolts per meter or kV/m). These units are measures of the difference in electrical voltage that exists between two points 1 meter apart (about 3 feet apart). The electric field becomes stronger near a charged object and decreases with distance away from the object. The electric field is a vector having both magnitude and direction as shown in Figure 3.4-1.

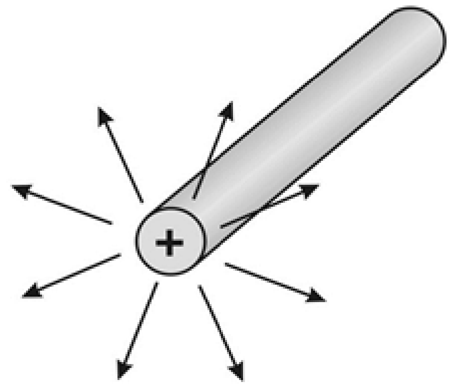


Figure 3.4-1: Electric Field around a Conductor

3.4.1.1 DC Electric Fields

Static or DC electric fields are very common phenomena. The earth creates a natural static electric field in fair weather that is a result of the 300,000 to 400,000 volt potential difference between the ionosphere and the surface of the earth (Veimeister 1972). The normal fair weather static electric field of the earth varies from month to month, reaching a maximum of about 20 percent above normal in January (when the earth is closest to the sun) and falling to about 20 percent below normal by July (when the earth is farthest from the sun). At ground level, the average value of the earth's DC electric field is approximately 120 V/m. This means that a 6-foot-tall person would have a difference in static voltage of about 220 volts between the top and bottom of their body.

Static electric fields can exist within storm clouds, where the electric potential of clouds (with respect to earth) can reach 10 to 100 million volts (Veimeister 1972). Natural static electric fields under clouds and in dust storms can reach 3 to 10 kV/m (CRC 1981).

Static electric fields can also result from friction generated when someone takes off a sweater, slides across a car seat, or walks across a carpet. For example, body voltages as high as 10–16,000 volts have been measured after walking across a carpet (Chakravarti and Pontrelli 1976). It is a common occurrence that someone receives a small shock (a discharge of built-up body voltage) when touching a doorknob after walking across a carpet.

3.4.1.2 AC Electric Fields

AC electric fields are different from static DC electric fields, since AC electric fields are caused by the changing direction of electric voltage while static fields have a constant voltage direction. In the United States, AC electric power transmission lines operate at a frequency of 60 Hertz (Hz) (i.e., the voltage reverses direction at a rate of 60 cycles per second). AC transmission lines therefore create 60Hz AC electric fields, which result from the voltage on the transmission line conductors with respect to the ground.

Electric fields from a transmission line decrease with distance away from the outermost conductor, typically at a rate of approximately one divided by the distance squared ($1/d^2$). Transmission line electric fields remain relatively constant over time because the voltage of the transmission line is kept within about ±5 percent of its rated nominal voltage.

Transmission line electric fields are affected by the presence of grounded and conductive objects, as demonstrated by Figure 3.4-2. Trees and buildings, for example, can greatly reduce ground level electric fields by shielding the area near the object (Deno and Silva 1987).

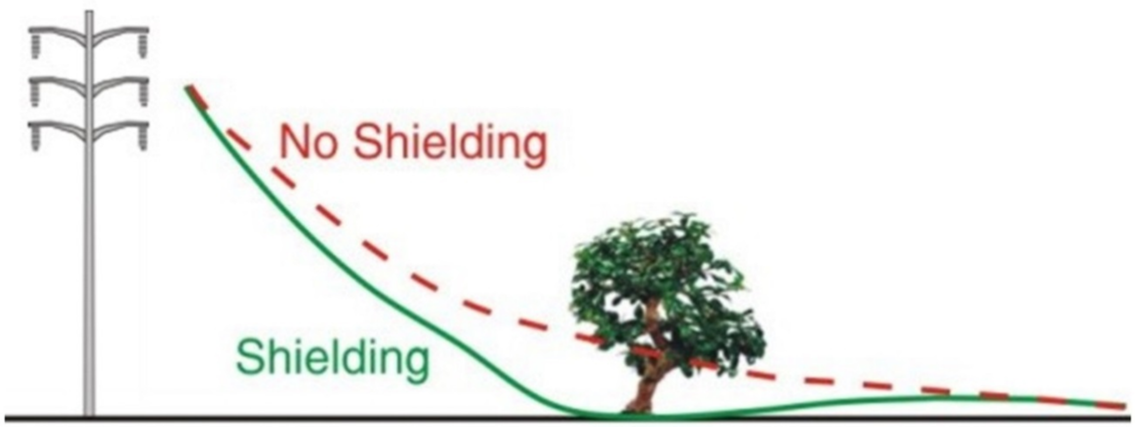


Figure 3.4-2: Electric Field Shielding Due to a Tree

Household appliances and other devices that operate on electricity also create AC electric fields. The electric field caused by small compact household appliances generally attenuates more rapidly with distance than transmission line electric fields. Appliances need not be in operation to create an electric field. Simply plugging an appliance into an electrical outlet creates an electric field around the outlet. Typical values of electric field measured 1 foot away from some common appliances are shown in Table 3.4-1.

Table 3.4-1:
Typical AC Electric Field Values for Appliances (at 12 Inches)

Appliance	Electric Field (kV/m)
Electric Blanket	0.25 [1]
Broiler	0.13
Refrigerator	0.06
Iron	0.06
Hand Mixer	0.05
Coffee Pot	0.03

1 One to 10 kV/m next to blanket wires.
Source: Carstensen (1987), Enertech Consultants (1985)

3.4.2 Magnetic Fields

An electric current (the flow of electrical charges or moving electrons) in a conductor or wire creates a magnetic field. The commonly used magnetic field intensity unit of measure is the gauss (G). For most applications, the gauss is too large, so a smaller unit, the milliGauss (mG), is used for reporting magnetic field magnitudes. The milliGauss is one thousandth of a gauss.

The magnetic field is a vector quantity having magnitude and direction. The magnetic field encircles the current in the wire and the direction of the magnetic field is dependent upon the direction of current flow as shown in Figure 3.4-3.

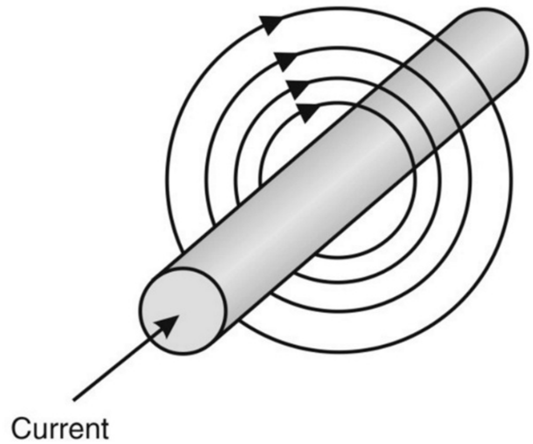


Figure 3.4-3: Magnetic Field around a Conductor

3.4.2.1 DC Magnetic Fields

Static or DC magnetic fields are very common phenomena. As a general reference, the earth has a natural static magnetic field of about 0.51 G, or 510 mG, in the Oklahoma/Arkansas/Tennessee area (Merrill and McElhinny 1983). Static magnetic fields are also found very close to everyday objects such as common refrigerator magnets (bar magnets) and radio/stereo speaker magnets (thousands of gauss field strength). Many appliances utilize DC charging current (chargeable electric razors, electric toothbrushes, electronic tablets, calculators, and other small appliances). Medical devices such as magnetic resonance imaging (MRI) machines utilize large DC magnetic fields to create scanned images (generally stronger than 10,000 G) (Olsen and Sheppard 2012).

3.4.2.2 AC Magnetic Fields

AC magnetic fields from electric power facilities and appliances differ from static (or DC) fields because they are caused by the flow of 60Hz alternating currents. Power frequency magnetic fields reverse direction at a rate of 60 cycles per second corresponding to the 60Hz operating frequency of electric power systems in the United States. Electric transmission lines therefore create 60Hz AC magnetic fields. These magnetic fields are generated by the current flowing on the transmission line conductors.

Similar to a transmission line AC electric field, the AC magnetic field typically decreases with the inverse square of the distance away from the transmission line ($1/d^2$). However, unlike AC electric fields that remain relatively constant over time, AC magnetic fields can vary considerably over time because the current on any transmission line changes in response to increasing and decreasing electrical load demands. Transmission line magnetic fields are also not easily shielded by objects, as are electric fields (EPRI 1999).

Since the magnetic field is caused by the flow of an electric current, a device must be operated to create a magnetic field. Magnetic field strengths of a large number of common household appliances were measured by the Illinois Institute of Technology Research (1984) for the U.S. Navy (Gauger 1985), and by Enertech Consultants for the Electric Power Research Institute (EPRI) (Silva et al. 1989). Typical magnetic field values for some appliances have been measured as low as 0.3 mG to as high as 20,000 mG (Table 3.4-2). It should be noted that anything that supplies or uses AC electrical power creates an AC magnetic field. There are other electric utility sources (e.g., distribution lines, power transformers, electrical panels, etc.), office sources (e.g., copiers, printers, computers, electric pencil sharpeners, etc.), school sources (overhead/slide projectors, aquariums, TV monitors, etc.), retail sources (e.g., refrigeration units, escalators, cash registers, etc.

Table 3.4-2:
AC Magnetic Fields from Household Appliances

Appliance	Magnetic Field at 12 inches Away (mG)	Maximum Magnetic Field (mG)
Electric Range	3 to 30	100 to 1,200
Electric Oven	2 to 25	10 to 50
Garbage Disposal	10 to 20	850 to 1,250
Refrigerator	0.3 to 3	4 to 15
Clothes Washer	2 to 30	10 to 400
Clothes Dryer	1 to 3	3 to 80
Coffee Maker	0.8 to 1	15 to 250
Toaster	0.6 to 8	70 to 150
Crock Pot	0.8 to 1	15 to 80
Iron	1 to 3	90 to 300
Can Opener	35 to 250	10,000 to 20,000
Blender, Popper, Processor	6 to 20	250 to 1,050
Vacuum Cleaner	20 to 200	2,000 to 8,000
Portable Heater	1 to 40	100 to 1,100
Fans/Blowers	0.4 to 40	20 to 300
Hair Dryer	1 to 70	60 to 20,000
Electric Shaver	1 to 100	150 to 15,000
Fluorescent Light Fixture	2 to 40	140 to 2,000
Fluorescent Desk Lamp	6 to 20	400 to 3,500
Circular Saws	10 to 250	2,000 to 10,000
Electric Drill	25 to 35	4,000 to 8,000

Source: Gauger (1984), Silva et al. (1989)

3.4.3 Transmission Line Audible Noise

The natural phenomenon of corona from a transmission line can create audible noise. Corona is an electrical discharge of energy that occurs on an energized surface such as a transmission line conductor (as shown in Figure 3.4-4). The electrical voltage at a specific location on an energized surface increases wherever surface irregularities occur (such as nicks on the transmission line conductor, water droplets, insects, or debris) to the point that the air surrounding that location becomes ionized and creates a tiny electrical discharge (EPRI 2010). Corona on high voltage transmission lines generates a small amount of sound or noise. The audible noise level can increase during foul weather conditions when the transmission line conductors are wet (during rain, snow, or fog) and at higher elevations. For example, water drops that collect on the surface of the conductors increase corona activity so that a crackling or humming sound may be heard near a transmission line. Audible noise decreases with distance from a transmission line.

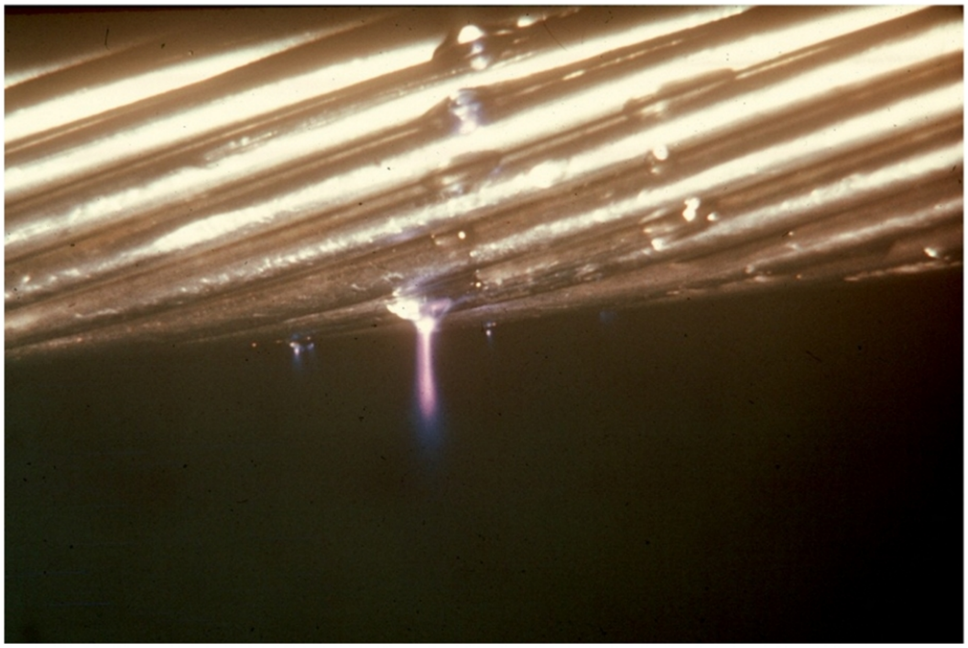


Figure 3.4-4: Close-up View of a Tiny Corona Discharge at the Surface of a Conductor

Audible noise is measured in decibels (dB), a logarithmic (i.e., dimensionless) unit that is the ratio of sound pressure to the threshold of human hearing. The apparent loudness that is attributed to sound varies not only with the sound pressure but also with the frequency (or pitch) of the sound. Since the human ear is not equally sensitive to sound at all frequencies, a specific frequency-dependent rating scale was devised (A-weighted dB scale, or dBA) to approximate the sensitivity of the human ear. This dBA scale has been chosen by most authorities for purposes of environmental noise regulation.

Typical sounds in a community may range from about 40 dBA (very quiet) to 100 dBA (very loud) or higher. Some typical noise levels range from the relative quiet of the library to the loud subway trains (Table 3.4-3).

Table 3.4-3:
Typical Sound Levels for Common Sources (in A-Weighted Decibels)

Source/Location	Sound Level (dBA)
Threshold of Hearing	0
Motion Picture Studio–Ambient	20
Library	35
Chicago Suburbs—nighttime minimum	40
Wind in Deciduous Trees (2–14 mph)	3–61
Falling Rain (Variable Rainfall Rates)	41–63

Table 3.4-3:
Typical Sound Levels for Common Sources (in A-Weighted Decibels)

Source/Location	Sound Level (dBA)
Tomato Field on California Farm	44
Small Town/Quiet Suburb	47–53
Private Business Office	50
Light Traffic at 100 feet Away	50
Average Residence	50
Large Retail Store	60
Accounting Office	60
Boston Inside House on Major Avenue	68
Average Traffic on Street Corner	75
Inside Sports Car (50 mph)	80
Los Angeles–0.75 mile from Jet Landing	86
Inside New York Subway Train	95
Loud Automobile Horn (at 1 meter)	115

Source: EPA (1974), IEEE (1974), Miller (1978)

It is important to remember that transmission line audible noise is variable and therefore is characterized using statistics that estimate the probability of a certain level of noise occurring. Statistical noise descriptors include what engineers call exceedance levels, for example, L10, L50, and L90. These descriptors indicate what percentage of time a certain noise level will be exceeded. For example, a L50 of 65 dBA indicates that 50 percent of the time, noise levels will be greater than 65 dBA at a certain location and conversely, it could be less than 50 percent of the time. Additional methods to characterize audible noise have been developed to evaluate the long-term characteristics of sound. The equivalent sound level, L_{eq}, is the average level of a varying sound over a specified period of time (EPA 1974; Keast 1980). This value is a single-number equal to the level of a constant unchanging sound.

Some government agencies have adopted a level similar to L_{eq} called the day-night averaged noise level (an equivalent day-night sound level, or L_{dn}). The L_{dn} represents a time-weighted 24-hour average noise level based on the A-weighted decibel for a variety of weather conditions. Time-weighted refers to the fact that noise occurring during certain sensitive time periods (nighttime, when other background sounds are relatively subdued) is adjusted for occurring at those times. L_{dn} includes an additional 10 dBA increase that is added to noise events occurring during the nighttime hours of 10 p.m. to 7 p.m. (because people are more sensitive to noise at night).

3.4.4 Radio and Television Noise Interference

In addition to audible noise, corona from a transmission line can also create radio and television noise. Sporadic pulses of current, such as those produced by corona and gap discharges (tiny electrical gaps between mechanically connected parts) generate electromagnetic energy over a broad range of frequencies, including the radio and television bands. Overhead transmission lines do not, as a general rule, interfere with radio or TV reception. Corona-generated radio frequency noise decreases with distance from a transmission line and also decreases with higher frequencies. (When it is a problem, it is usually for amplitude modulation (AM) radio and usually not the higher frequencies associated with TV or satellite signals.) The severity of interference depends on the strength and quality of the transmitted radio or TV signal, the quality of the radio or TV set and antenna system, and the distance between the signal receiver (radio or TV) and the transmission line. The units used for radio or TV noise are decibels referenced to 1 μV/m (or one-millionth of a volt per meter) and written as dBμV/m.

It is difficult to determine whether the radio frequency noise level produced by a transmission line will cause unacceptable interference, because the strength of the received signal, the sensitivity of the receiver, the orientation of the receiving antenna, and the ambient radio frequency noise are all important parameters in determining the degree to which noise from the transmission line may cause signal degradation. A common measure to evaluate possible interference levels is the signal-to-noise ratio (SNR): the ratio of average signal power to average noise power (for a given frequency bandwidth). Based upon listening tests, if the limit of tolerability is assessed as the point at which reception quality becomes less than satisfactory, then the radio interference level of a transmission line should be 22 dB or more below the average strength of the desired radio signal (EPRI 2006a). For television interference, an SNR of at least 30–40 dB is required if corona noise is not to cause objectionable interference (EPRI 2006a). Radio and TV noise levels caused by the proposed transmission line can be computed, but without knowing broadcast signal strengths at various locations of interest along the possible line routes, it is difficult to determine that a tolerable SNR criterion would be met.

Corona-generated noise may also potentially impact amateur radio station operators. Amateur radio operators often try to receive broadcast signals down at the lowest level of noise, so additional noise from a transmission line may impact the signal reception. In addition, there are many parameters that may influence signal reception, including the broadcast signal frequency, direction of the signal, alignment of the receiver antenna, quality of the radio station equipment, terrain variations and altitude, and especially weather conditions. Because of these various parameters, it is not feasible to precisely determine whether a particular level of transmission line radio frequency noise will cause unacceptable interference to a nearby amateur radio station operator. Transmission line owners are required to resolve interference complaints from licensed operators in accordance with the Federal Communications Commission (FCC) Rules and Regulations at 47 CFR Part 15.

An important new issue is the radio and TV conversion to digital broadcast system technology. Low levels of interference may not noticeably affect a digital receiver's performance but higher levels may break up or stop reception. In principle, the new digital signal should be less susceptible to interference than an old analog signal (Smith 2004). The quality of digital reception should be better in a given noise level and would stay good at SNRs beyond which the old analog reception is no longer viable. These results have been documented in previous studies, such as the FCC study (FCC 1999), which indicated that digital signals will provide superior coverage and immunity to impulse noise (such as noise interference from household appliances as well as power lines) than analog signals. The International Electrotechnical Commission has endorsed the Digital Radio Mondiale on-air system, which is expected to be built to be immune to atmospheric electro-magnetic interference (EMI), and therefore are highly likely to be immune to power line EMI as well (EPRI 2006a). As new digital receivers emerge for high definition television and other applications, more testing will need to be performed to determine their susceptibility to power line interference (EPRI 2006a). No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1 gigahertz (GHz) from satellites. A possible problem could be a transmission tower in the direct line-of-sight between a dish antenna and a satellite, but this could be resolved by moving the dish antenna to a different location.

Questions sometimes arise about use of GPS devices in close proximity to high voltage transmission lines. The concern is that GPS units are unable to receive a signal from the satellites and that this will negatively affect agricultural operations that require GPS. In general, interference noise must be in the same frequency band as the band in which GPS receivers operate. Transmission lines produce little to no noise in the microwave bands used by GPS systems. Research performed on this subject did not reveal a problem for the high-quality receivers used in precision agriculture or agriculture-related aviation (Silva and Olsen 2002).

There are also important differences between DC and AC radio noise. Results from laboratories, tests, and operating DC lines have shown that the highest levels of radio noise occur during fair, dry weather rather than wet weather as for AC lines. While water drops are very effective corona sources, the ionization of air near the surface of DC line conductors in wet weather is very intense and has the effect of maintaining the electric field at a relatively low level near the surface of the conductors (EPRI 2010). The positive pole of a bipolar HVDC line also produces the greatest amount of radio noise (to the extent that noise generation from the negative pole can be ignored), whereas all conductors generate noise for AC transmission lines (EPRI 2010).

3.4.5 Ozone and Air Ions

Corona from a transmission line can also create oxidants such as ozone and air ions. Ozone consists of three oxygen molecules and is measured in parts per billion (ppb). The energy emission during corona on a transmission line ionizes (electrically charges) the surrounding air, creating ozone. Air ions are also produced when high voltage corona ionizes air molecules and these are measured in ions per centimeter cubed (ions/cm^3). Negative ions are particles with one or more extra electrons (resulting in a net negative charge) while positive ions are missing one or more electrons (resulting in a net positive charge). Air ions are present throughout the earth's atmosphere and occur during weather events (thunderstorms, lightning, rain), thermal combustion (a candle flame, internal combustion engines), water droplet formation (near waterfalls or in rain), and radioactivity as shown in Table.3.4-4 (EPRI 2012; Olsen and Sheppard 2012). Several factors influence the rate of generation of these elements, the most important being the transmission line conductor characteristics, mode of corona discharge, and the ambient weather conditions—i.e., temperature, humidity, precipitation, direction and intensity of wind speed, and terrain topography. Precipitation on a conductor surface decreases the conductor surface irregularity and increases corona losses, so rainy conditions, therefore, produce one of the highest levels of ozone generation on transmission lines. The presence of water and humidity, although it increases the efficiency of ozone generation, it makes ozone decay faster than in dry weather. Results of careful studies in the laboratory and measurements near transmission lines indicate that it would be unlikely that air ions and ozone from transmission lines would cause adverse health effects (EPRI 2012). Some effects have been reported, but the findings are inconsistent, and many studies have reported no effect (EPRI 2010).

Table 3.4-4:
Air Ion Concentrations for Selected Environments

Environment	Air Ion Concentration (ions/cm^3)		
	Total	Positive	Negative
Ambient (typical)	$1x10^3$ to $2x10^3$	$5x10^2$ to $1x10^3$	$5x10^2$ to $1x10^3$
Thunderstorm	$2.1x10^4$	$7x10^3$	$1.4x10^4$
Rain (increments above ambient)		$6x10^2$	$9x10^2$
Waterfall (increments above ambient)	$1.5x10^4$ to $2.7x10^4$	$2.2x10^2$ to $5.6x10^2$	$1.5x10^2$ to $5.4x10^3$
Burning Match (30 centimeters above match)	$2x10^5$ to $3x10^5$		
Cave (radioactive rock)	$15.4x10^5$	$6.7x10^5$	$6.7x10^5$
Maximum Measured Under HVDC Transmission Line (±400 and 500kV)	$3x10^5$		

Source: EPRI (2012)

3.4.6 Regulatory Background

Neither the state governments of Oklahoma, Arkansas, Tennessee, or Texas in which the Project will be constructed and operated, nor the federal government, have any statues or regulations relating to DC or AC electric and magnetic fields or radio and television interference specific to transmission lines. In the absence of any statutes or regulations, recommendations and guidelines of other state, international, and non-regulatory agencies have been consulted as an aid to the evaluation of potentially adverse impacts. The basis for some of these guidelines and recommendations and how they were developed is not always clearly defined, and not all of them represent science-based exposure limits to protect health and safety. It is also important to note that recommendations proposed to protect health and safety typically incorporate additional “safety” or “uncertainty” factors. However, the EPA has established guidelines for audible noise and ozone/air ions, which are also electrical effects associated with transmission lines.

The DOE has participated in two publications that summarize EMF: Questions and Answers About EMF, Electric and Magnetic Fields Associated with the Use of Power (NIEHS and DOE 1995) and EMF Electric and Magnetic Fields Associated with the Use of Electric Power, Questions and Answers (NIEHS and NIH 2002). These booklets contain information describing the principals of EMF, an overview of the results of major studies, and summarize the conclusions of expert review panels (additional discussion on this topic is presented in Section 3.4.11.2.1.2.2.7).

3.4.6.1 DC Electric Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have DC electric field exposure limits. Non-regulatory organizations have established or recommended the following DC electric field exposure limits:

- The International Committee on Electromagnetic Safety (ICES), which is a technical committee within the Institute of Electrical and Electronics Engineers (IEEE), has established a guideline of 20 kV/m (thousands of volts per meter) for occupational exposure and 5 kV/m for public exposure at 0 Hz (ICES 2002).
- The American Conference of Governmental Industrial Hygienists (ACGIH) has established an occupational guideline of 25 kV/m (ACGIH 2010), which is an industrial/occupational standard that is designed to protect workers in high field environments and not a public exposure standard. Public (non-occupational) exposure would be incidental/short-term exposure within and near the transmission line ROW. It is not clear how applicable this standard would be to construction and operation of the Project.
- The International Committee on Non-Ionizing Radiation Protection (ICNIRP) has established a guideline of 20 kV/m for occupational exposure and 5 kV/m for public exposure at 1 Hz (ICNIRP 2010). This guideline is an international standard and is provided as an aid for DC electric field evaluation.

The consensus of these non-regulatory groups indicates that public exposure to DC electric field should be limited to 5 kV/m (with occupational exposure limited to the range of 20 to 25 kV/m).

3.4.6.2 AC Electric Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have AC electric field exposure limits. Non-regulatory organizations have established or recommended the following AC electric field exposure limits:

- The ICES, which is a technical committee within the IEEE, has established a guideline of 20 kV/m for occupational exposure, 10 kV/m within a transmission line ROW, and 5 kV/m for public exposure (ICES 2002).
- The ACGIH has established an occupational threshold of 25 kV/m, and for workers with implanted medical devices (such as cardiac pacemakers) the recommended limit is 1 kV/m (ACGIH 2010). Manufacturers of implanted medical devices often provide specifications about AC electric field thresholds to patients, and these may be different from the ACGIH recommendation (additional discussion on this topic is presented in Section 3.4.11.2.1.2.2.8). The ACGIH standard is an industrial/occupational standard (which is designed to protect workers in high field environments) and not a public exposure standard. Public (non-occupational) exposure may typically be incidental/short-term exposure within and near the transmission line ROW and it is not clear how applicable this standard would be in these situations.
- Although the states of Oklahoma, Arkansas, Tennessee, and Texas do not have electric field standards for transmission lines, at least six other states have established regulations regarding electric fields (either within the ROW or at the ROW edges, as shown in Table 3.4-5) (NIEHS and NIH 2002). Within the ROW, thresholds range from 7 kV/m to 11.8 kV/m, depending upon the state. At the ROW edges, thresholds range from 1 to 3 kV/m, depending upon the state. These regulations are engineering standards (rather than health-based standards) so that new transmission lines will have similar field levels to existing, operational transmission lines or are safety-based engineering standards to establish electric field levels to limit electric discharges that could cause a nuisance shock.

Table 3.4-5:
Summary of State Transmission Line Standards and Guidelines for AC Fields[1]

	AC Electric Field		AC Magnetic Field	
State	On ROW	ROW Edge	On ROW	ROW Edge
Florida*	8 kV/m[a] 10 kV/6 [b]	2 kV/m	—	150 mG[a] (max load) 200 mG[b] (max load) 250 mG[c] (max load)
Minnesota	8 kV/m	—	—	—
Montana	7 kV/m[d]	1 kV/m[e]	—	—
New Jersey	—	3 kV/m	—	—
New York	11.8 kV/m 11.0 kV/m[f] 7.0 kV/m[d]	1.6 kV/m	—	200 mG (max load)
Oregon	9 kV/m	—	—	—

* ROW includes certain additional areas adjoining the ROW for Florida only
a For lines of 69–230kV
b For 500kV lines
c For 500kV lines on certain existing ROW
d Maximum for highway crossings
e Applies in residential and subdivided areas and may be waived by the landowner
f Maximum for private road crossings
Source: NIEHS and NIH (2002)

1 None of these states are locations where the Project will be constructed and operated. Field values are provided as an aid for AC electric and magnetic field evaluation.

- The NESC requires that the electric field be reduced such that the largest anticipated object underneath an overhead transmission line has a current to ground of no greater than 5 milliamps (mA). High voltage transmission lines can induce a voltage, and therefore induce electric currents, in metallic objects such as a truck parked under the transmission line. The NESC therefore requires that additional ground clearance or other means shall be used to limit anticipated electric field effects to 5 mA or less (IEEE 2007).
- The ICNIRP has established a guideline of 8.3 kV/m for occupational exposure and 4.2 kV/m for public exposure at 60 Hz (ICNIRP 2010). This guideline is an international standard and is provided as an aid for AC electric field evaluation.

The consensus of these non-regulatory groups indicates that public exposure to 60 Hz AC electric field should be limited to 5 kV/m or less (with occupational exposure limited to the range of about 8 to 25 kV/m). For occupational workers with implanted medical devices, a limit of 1 kV/m has been recommended (ACGIH 2010). Specifically for a transmission line, a limit of 10 kV/m has been recommended within the ROW (ICES 2002).

3.4.6.3 DC Magnetic Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have DC magnetic field exposure limits. Non-regulatory organizations have established or recommended the following DC magnetic field exposure limits:

- The ICES, which is a technical committee within the IEEE, has established a guideline of 3,530 G for occupational exposure and 1,180 G for public exposure at 0 Hz (ICES 2002).
- The U.S. Food and Drug Administration (FDA) has established a limit of 40,000 G for medical patients receiving MRI treatments and 5 G for patients with pacemakers (FDA 1998).
- The ACGIH has established an occupational guideline of 20,000 G for whole body exposure and 5 G for persons with implanted medical devices (ACGIH 2010). Manufacturers of implanted medical devices often provide specifications about DC magnetic field thresholds to patients, which may be different from the ACGIH recommendation (additional discussion on this topic is presented in Section 3.4.11.2.3.2.7). The ACGIH standard is an industrial/occupational standard (which is designed to protect workers in high field environments) and not a public exposure standard. Public (non-occupational) exposure may typically be incidental/short-term exposure within and near the transmission line ROW and it is unclear how applicable this standard would be in these situations.
- The ICNIRP has established a guideline of 20,000 G for occupational exposure, 4,000 G for public exposure, and 5 G for persons with implanted medical devices (ICNIRP 2009). This is an international standard and is provided as an aid for AC electric field evaluation.

The consensus of these non-regulatory groups indicate that public exposure to DC magnetic field should be limited to the range of 1,180 to 4,000 G (with occupational exposure limited to the range of 3,530 to 20,000 G). For people with implanted medical devices, a limit of 5 G has been recommended.

3.4.6.4 AC Magnetic Field Exposure Guidelines

No federal regulatory agencies or state agencies in which the Project will be operated (Oklahoma, Arkansas, Tennessee or Texas) have AC magnetic field exposure limits. Non-regulatory organizations have established or recommended the following AC magnetic field exposure limits:

- The ICES, which is a technical committee within the IEEE, has established a guideline of 27.1 G for occupational exposure and 9.0 G for public exposure to 60 Hz magnetic fields (ICES 2002).
- The ACGIH has established an occupational threshold of 10 G, and for workers with implanted medical devices (such as cardiac pacemakers) the recommended limit is 1 G (ACGIH 2010). Manufacturers of implanted medical devices often provide specifications about AC magnetic field thresholds to patients, which may be different from the ACGIH recommendation (additional discussion on this topic is presented in Section 3.4.11.2.1.2.2.8). The ACGIH standard is an industrial/occupational standard (which is designed to protect workers in high field environments) and not a public exposure standard. Public (non-occupational) exposure may typically be incidental/short-term exposure within and near the transmission line ROW and it is not clear how applicable this standard would be in these situations.
- Although the states of Oklahoma, Arkansas, Tennessee, and Texas do not have magnetic field standards for transmission lines, at least two other states have established regulations regarding magnetic field at the ROW edges (levels range from 150 to 250 mG, depending upon the state) as summarized in Table 3.4-5 (NIEHS and NIH 2002). These regulations are engineering standards (rather than health-based standards) so that new transmission lines will have similar field levels to existing operational transmission lines.
- The ICNIRP has established a guideline of 10 G for occupational exposure and 2 G for public exposure (ICNIRP 2010). This is an international standard and is provided as an aid for AC electric field evaluation.

The consensus of these non-regulatory groups indicate that public exposure to AC magnetic field should be limited to the range of 2 to 9 G (2,000 to 9,000 mG) (with occupational exposure limited to the range of 10 to 27.1 G). For occupational workers with implanted medical devices, a limit of 1 G has been recommended (ACGIH 2010).

3.4.6.5 Audible Noise Exposure Guidelines

Regulatory organizations have established or recommended the following audible noise exposure limit:

- The EPA has established an outdoor activity L_{dn} noise guideline of 55 dBA (EPA 1974). This value represents the sound energy averaged over a 24-hour period; it has a 10 dBA nighttime weighting (between 10:00 p.m. and 7:00 a.m.) (EPRI 2006a). The noise level is applicable to outdoor residential areas and farms and other outdoor areas where people spend time.

No other local noise ordinances establishing numerical limits were identified (Clean Line 2014a).

3.4.6.6 Radio and Television Noise Exposure Guidelines

Regulatory and non-regulatory organizations have established the following exposure limits for radio and television noise interference:

- The FCC has established that if unacceptable interference from transmission lines is present at nearby amateur radio stations (i.e. notification to an FCC representative that harmful interference is present), the owners of the transmission line are required to resolve interference complaints from licensed operators in accordance with the FCC Rules and Regulations requirements at 47 CFR Part 15.
- The IEEE established the Radio Noise Design Guide of 56 dBμV/m at a frequency of 1 million hertz (MHz) measured at 15 meters (50 feet) from the outside conductor in fair weather (IEEE 1971), which was modified by IEEE to a standard frequency of 0.5MHz by IEEE Standard 430-1986 (IEEE 1986) and corresponds to 61 dBμV/m at 0.5MHz (Olsen 2014). However, this is a design guide rating for acceptable noise performance;

actual performance is dependent upon many parameters that may influence signal reception (IEEE 1971), including the broadcast signal frequency, direction of the signal, alignment of the receiver antenna, quality of the radio station equipment, terrain variations and altitude, and, especially, weather conditions.

3.4.6.7 Ozone/Air Ion Concentration Exposure Guidelines

Regulatory organizations have established the following exposure limits for ozone concentration:

- The EPA ozone standard is in terms of 8-hour average exposures to a level of 75 ppb (EPA 2008).
- The states of Oklahoma (ODEQ 2013), Arkansas (ADEQ 2014), and Tennessee (TDEC 2014) have endorsed and adopted the EPA ozone standard (EPA 2008).

3.4.7 Data Sources

Transmission line geometry and loading information was provided in the Applicant's Technical Report on the Electrical Environment Assessment of the Plains and Eastern Transmission Line Project (Clean Line 2014b).

Land use information was provided in the Applicant's Land Use and Recreation Technical Report for the Plains and Eastern Transmission Line Project (Clean Line 2013) and is also discussed in Section 3.10.

Weather information was provided by the U.S. National Oceanic and Atmospheric Administration website (http://www.noaa.gov), the Weather Underground website (http://www.wunderground.com), and the Weather Channel website (http://www.weather.com).

Locations where existing AC transmission lines are present along the proposed HVDC overhead electric transmission line route were evaluated using GIS files provided by the Applicant.

3.4.8 Region of Influence

3.4.8.1 Region of Influence for Project and DOE Alternative

The ROI associated with the Project is the transmission line ROW for the HVDC transmission line and for all AC transmission lines as described in Section 3.1.1. The precise ROW width has not yet been determined for each route section, and could vary from 150 to 200 feet in width. Certain electrical effects may extend beyond the ROW edges, so this evaluation was extended to include a distance of 200 feet beyond the maximum assumed ROW edges (which corresponds to a total of 300 feet on either side of centerline for the HVDC transmission line) and AC collection system routes.

For the AC/DC converter stations, the ROI is the potential siting areas for each converter station within which the converter station would be located (as described in Section 3.1.1). However, the dominant sources of electrical effects are the overhead transmission lines entering and exiting these stations. Some types of substation and switching station equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise, and converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Computer modeling and calculations of electrical effects for the proposed converter stations were therefore not performed, except for audible noise as described in Section 3.11.6.

3.4.8.2 Region of Influence for Connected Actions

The ROI for wind energy generation, the future Optima substation, and TVA upgrades is described in Section 3.1.1.

3.4.9 Affected Environment

The affected environment would include the proposed transmission line ROWs through Oklahoma, Arkansas, Tennessee, and Texas (i.e. the transmission line ROI) and the proposed converter stations. The primary electrical component of the project is the approximately 720-mile-long ±600kV HVDC overhead electric transmission line that would be routed within each state. At each end of the DC transmission line, AC/DC converter stations are required to convert DC electricity to AC electricity for interconnection into the AC electrical grid. One double circuit AC transmission line of up to 345kV would be required to connect the Oklahoma converter station, while two 500kV AC transmission lines would be required to connect the Tennessee converter station. An additional converter station could be sited in Pope County, Arkansas, as part of the DOE alternatives. This alternative converter station would be similar to the Texas County or Shelby County or Tipton County converter stations. One 500kV AC transmission line would be required to connect the Arkansas converter station alternative to an interconnection point along an existing 500kV transmission line in Arkansas. Four to six AC transmission lines are also proposed to transport AC electrical power (the AC collection system) from wind farm generation in Oklahoma to the converter station in Oklahoma. Detailed information regarding the transmission line configurations, convertor stations, and transmission line routes are described in Chapter 2 and in Appendix F.

3.4.10 Regional Description

The Project (which includes the HVDC transmission line, AC collector lines, and convertor stations) would be located in Oklahoma, Arkansas, Tennessee, and Texas. Locations within these four states have been divided into seven different regions, primarily based upon the routing of the HVDC transmission line (including the applicant proposed and alternative routes). Detailed information regarding each of the proposed transmission line routes can be referenced in Chapter 2.

Existing sources of electrical effects are present along each of the transmission line routes. These effects include static and power-frequency fields as well as radio frequency signals. Sources of these effects include existing power lines, communications equipment, and other related sources. Since the use of electricity is an integral part of our modern lifestyle, these effects are commonly found in our everyday environment and, therefore, within each of the Project regions being evaluated.

As previously discussed, static (DC) electric and magnetic fields are a common, natural phenomenon. Static electric fields are present in our environment due to the difference in voltage potential between the ionosphere and the surface of the earth. The earth's magnetic field is a natural static field, whose intensity is about 0.51 G, or 510 mG, in the Oklahoma/Arkansas/Tennessee area where the HVDC transmission line would be constructed. Many household appliances also utilize DC charging current (e.g., chargeable electric razors and electric toothbrushes). AC electric and magnetic fields exist wherever electricity is generated, transmitted, or distributed in power lines or cables or used in electrical appliances. Existing high voltage AC electric transmission lines are therefore present in power line corridors within each Project state. Overhead AC distribution lines are also commonly present along roadways and in towns, providing lower voltage electrical service directly to residents, farms, businesses, and industries in each local area. These existing power lines all produce AC electric and magnetic fields that currently contribute to the existing overall field environment. In our homes, electrical appliances are also sources of AC electric and magnetic field.

At numerous locations within each region, the proposed HVDC transmission line is located parallel to other existing AC transmission lines. In these situations, electrical effects from existing AC transmission lines may influence effects associated with the proposed HVDC transmission line by itself (effects could be additive or subtractive). Because the HVDC transmission line route has not yet been selected, and given the numerous existing AC transmission lines present along various routes and regions, calculations of the combined electrical effects was not performed for these situations.

Audible noise is present in our environment. We experience sounds from nature (e.g. birds singing, dogs barking, thunder, etc.) as well as manmade noises (e.g. automobiles, music, human speech). Existing high voltage transmission lines may also contribute to the audible environment by creating a humming sound (resulting from the discharge of energy which that occurs on the energized surface of the transmission line conductors) within their immediate proximity. Transmission line audible noise can increase during foul weather conditions when the conductors become wet (during rain, snow, or fog) and at higher elevations. Existing high voltage AC electric transmission lines are present within each Project state, and the contribution of some transmission line audible noise is therefore also present within each region.

Existing radio frequency sources would also be present within each region of the Project. Sources such as cellular telephone antennas and microwave antennas are often located on communication towers near interstates, on tall buildings, and on power line structures. Radio and television broadcast station signals are also present within the existing environment. GPS transmitters and receivers, which utilize radio frequency and/or satellite signals, are common in automobiles, trucks, and farm equipment. In addition, equipment such as wireless routers utilize radio frequency signals to provide a communication link between computers, cellular telephones, printers, and other electronic devices. The presence of existing radio frequency signals is a very common occurrence as demonstrated by the abundance of sources that can be found in our modern society.

Within each of the following regional descriptions, the number of existing AC transmission lines present that would parallel the Project line was estimated using GIS (geographic information system) files provided by the Applicant (GIS Data Source: Clean Line 2013a, 2013b) and Tetra Tech (GIS Data Source: Tetra Tech 2014a). Radio frequency sources such as microwave and communication towers were also enumerated along the proposed HVDC routes using information provided by the FCC (GIS Data Source: FCC 2012). In evaluating the electrical effects for each region, one of the primary factors of importance would include the number of residences present along the HVDC electric transmission line route. The number of residences and other building structures were therefore also enumerated from information provided by the Applicant (GIS Data Source: Clean Line 2013a). Overall, the environment is predominantly rural agricultural land or forested land interspersed with residential areas. Detailed land use information is presented in detail in Section 3.10.

3.4.10.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route, Alternative Routes 1-A through 1-D, AC collection system of up to 345kV, the Oklahoma converter station, and potentially the future Optima substation. The westernmost portion of the HVDC transmission line would be connected into the Oklahoma converter station located in Texas County, Oklahoma. The HVDC transmission line could parallel at least three other overhead AC transmission lines within this region (ranging from 69kV to 345kV in voltage). Table 3.4-6 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 1. Table 3.4-7 provides the number of residences located within the ROI for the AC collection system. There are no residences within the ROI for the Oklahoma Converter Station Siting Area or AC Interconnection Siting Area.

Table 3.4-6:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 1

HVDC Transmission Line Routes	Number of Residences
APR	8
AR 1-A	7
AR 1-B	3
AR 1-C	6
AR 1-D	9

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

Table 3.4-7:
Residences Located Within the ROI for the AC Collection System

AC Collection System	Number of Residences
E-1	193
E-2	19
E-3	39
NE-1	48
NE-2	24
NW-1	25
NW-2	44
SE-1	7
SE-2	10
SE-3	19
SW-1	8
SW-2	10
W-1	5

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. The HVDC transmission line could parallel at least three other overhead AC transmission lines within this region (all 115kV voltage). Table 3.4-8 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 2.

Table 3.4-8:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 2

HVDC Transmission Line Routes	Number of Residences
APR	26
AR 2-A	5
AR 2-B	2

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. The HVDC transmission line could parallel at least eleven other overhead AC transmission lines within this region (ranging from 69kV to 345kV in voltage). Table 3.4-9 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 3.

Table 3.4-9:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 3

HVDC Transmission Line Routes	Number of Residences
APR	114
AR 3-A	13
AR 3-B	26
AR 3-C	102
AR 3-D	40
AR 3-E	20

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation[2]. The HVDC transmission line could parallel at least 13 other overhead AC transmission lines within this region (ranging from 69kV to 345kV in voltage). Table 3.4-10 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 4.

Table 3.4-10:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 4

HVDC Transmission Line Routes	Number of Residences
APR	151
AR 4-A	103
AR 4-B	107
AR 4-C	6
AR 4-D	67
AR 4-E	61
Lee Creek Variation	0

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

[2] The Lee Creek Variation is a variation of the Applicant Proposed Route that was created in response to scoping comments from the City of Fort Smith, Arkansas expressing concern about the proximity of the proposed route to the Lee Creek Dam and Reservoir.

3.4.10.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route, HVDC Alternative Routes 5-A through 5-F, and Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area. The HVDC transmission line could parallel at least two other overhead AC transmission lines within this region (138kV and 500kV in voltage). Table 3.4-11 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 5. There are 152 residences within the Arkansas Converter Station Alternative Siting Area. There are 38 residences within the Arkansas AC Interconnection Siting Area.

Table 3.4-11:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 5

HVDC Transmission Line Routes	Number of Residences
APR	81
AR 5-A	54
AR 5-B	11
AR 5-C	6
AR 5-D	50
AR 5-E	24
AR 5-F	20

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. It should be noted that the Cache/Lower White River systems are designated as a "wetlands of International Importance" under the Ramsar Convention on International Wetlands, and the Cache River is a forested wetland crossed by the ROI area. The HVDC transmission line could parallel at least one other overhead AC transmission line within this region (161kV voltage). Table 3.4-12 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC Alternative Routes within Region 6.

Table 3.4-12:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 6

HVDC Transmission Line Routes	Number of Residences
APR	26
AR 6-A	6
AR 6-B	2
AR 6-C	16

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route, Alternative Routes 7-A through 7-D, 500kV transmission collector lines, and the Shelby Converter Station. The HVDC transmission line could parallel at least four other overhead AC transmission lines within this region (ranging from 161kV to 500kV in voltage). Table 3.4-13 provides the number of residences located within the ROI for the Applicant Proposed Route and HVDC alternative routes within Region 6. There are two residences within the Shelby Converter Station Siting Area and AC Interconnection Siting Area.

Table 3.4-13:
Residences Located Within the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 7

HVDC Transmission Line Routes	Number of Residences
APR	30
AR 7-A	12
AR 7-B	10
AR 7-C	44
AR 7-D	30

GIS Data Sources: Clean Line (2013a, 2013b), Tetra Tech (2014a)

3.4.10.8 Connected Actions

3.4.10.8.1 Wind Energy Generation

Wind energy generation facilities may be interconnected to the Project's ±600kV HVDC overhead electric transmission line to transport electricity. Electrical equipment associated with wind farms can include wind turbine generators, underground collection cables, substation with electric transformers, and AC transmission lines to connect the wind power generation to the electrical grid. Most of this equipment is located within the generation facility itself.

Wind energy generation facilities require AC transmission lines to interconnect into the electrical grid. Any generation transmission interconnection lines would be similar in size and voltage to the transmission lines associated with the AC collection system. Therefore, the regions where existing environmental conditions and the potential effects associated with these wind generation interconnection lines would be similar to the AC collection system transmission lines (Clean Line 2014b, 2014c).

3.4.10.8.2 Optima Substation

The future Optima substation would be constructed on approximately 160 acres partially within the area identified on Figure 2.1-3 as the AC interconnection siting area.

3.4.10.8.3 TVA Upgrades

As described above under Section 3.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.4.11 Electrical Environment Impacts

This section describes the electrical environment and environmental impacts associated with the AC/DC converter stations (located in Oklahoma, Arkansas, and Tennessee), the ±600kV HVDC overhead electric transmission line, the AC transmission line interconnections, and the AC transmission line collection system alternatives. The electrical effects evaluated include electric and magnetic fields, air ions and ozone, audible noise, and radio and television interference.

3.4.11.1 Methodology

Computer modeling was performed to calculate values for electrical effects associated with each of the proposed transmission line configurations. For the AC/DC converter stations, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the stations. Some types of substation and switching station equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods (CRC 2007), and Project converter stations are planned to be located in either rural areas or areas where other electrical substations already exist; therefore computer modeling and calculations of electrical effects for the proposed converter stations was not performed, except for audible noise as described in Section 3.11.6. Detailed calculation results are presented in Appendix I.

Two different configurations were evaluated for the proposed ±600kV HVDC overhead electric transmission line (bi-polar monopole and bi-polar lattice configurations), while nine different configurations were evaluated for the proposed AC collection system routes and converter station interconnections (five 345kV and four 500kV configurations). All of the computer modeling data related to line design configuration, conductor specifications and spacing, loading, and other parameters were provided by the Applicant (GIS Data Source: Clean Line 2013a).

Calculations were performed using the minimum midspan conductor clearance for all electrical effects except audible noise. For audible noise, calculations are performed using the minimum midspan conductor clearance plus one-third of the sag (which represents an average conductor height along the entire span between support structures) (EPRI 2006a). For transmission line corona effects, conservative assumptions for overvoltage conditions and ground elevation were used to calculate effects. Voltage levels for a high voltage transmission line are typically held relatively constant (within ±5-10 percent) while the load on the line is allowed to fluctuate with demand. A conservative overvoltage condition was assumed for all transmission lines (+5 percent for 345kV AC, +10 percent for 500kV AC, and approximately +5 percent for ±600kV DC) as cited by the Applicant (Clean Line 2014b). In addition, higher elevations accentuate corona effects, so the highest reported altitude along the Project routes (an elevation of 3,000 feet above sea level) was used. These conservative assumptions are used to calculate a maximum electrical effect value; at lower elevations, for lower voltage conditions, or for higher conductor ground clearances, the calculated electrical effects values will be lower. For AC and DC magnetic fields, two different loading conditions were modeled: average and maximum loading.

For electric and magnetic fields, calculations were performed at a height of 3.28 feet (1 meter) in accordance with IEEE Standards (IEEE 1994). For audible noise, calculations were performed at a height of 4.9 feet, which approximates the height of a human ear. For radio noise, calculations were performed at an antenna height of 6.6 feet in accordance with IEEE Standards (IEEE 1986). For television noise, calculations were performed at an antenna height of 9.8 feet. The reference frequency for the calculations is 0.5MHz for radio noise and 75MHz for TV noise. For ozone and air ions, calculations were performed at ground level (EPA 2014). Audible noise and radio noise calculation results are presented for both fair and rainy weather, while television noise and ozone are presented for rainy weather only.

Environmental conditions were assumed to be at an elevation of 3,000 feet above sea level (corona effects are accentuated at higher elevations and this elevation represents the highest reported altitude along the Project routes), with a wind speed of 8.5 miles per hour (mph) and rain rate of 0.1 inch/hour. The assumed wind speed and rain rate are calculated averages based upon 2013 monthly weather data for the cities of Oklahoma City, Little Rock, and Memphis.

For electrical effects associated with the ±600kV HVDC overhead electric transmission line, the EPRI Transmission Line Workstation software program Version 3.0 (specifically the ACDC Line module) was used to perform the computer modeling (EPRI 1996, 2006b). For electrical effects associated with the AC transmission line collection system alternatives and interconnections, three different software programs were used for calculations. For electric and magnetic fields, the EPRI EMFWorkstation 2013 software program was used (EPRI 2013b). For audible noise, the EMFWorkstation software Version 2.51 (specifically the ENVIRO Version 3.52 module) was used to calculate L_{dn} noise levels (EPRI 1997). For all other electrical effects, the Bonneville Power Administration Corona and Field Effects software program was used (BPA 1977).

The Applicant has developed a comprehensive list of EPMs that is provided in Appendix F. Since these EPMs would be adopted, calculations assume the use of these EPMs throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE alternatives.

For electrical effects, EPMs will involve the use of line design configurations and conductor types to reduce effects at and beyond the ROW edges. The Applicant has proposed using “optimal phasing” for the proposed AC transmission collection lines to reduce EMF at the ROW edges for double circuit configurations (Clean Line 2014a).

Optimal phasing takes into account the direction of current flow in all circuits to determine the appropriate phasing sequence for maximizing magnetic field reduction. For double circuit (or multiple circuit) lines located together on the same support structure (or in close proximity to one another), the overall magnetic field generated from the lines will be dependent upon the arrangement of each circuit’s phase sequence (among other parameters). Circuits can be arranged so that the phase sequence for one circuit is placed adjacent to the same phase sequence of the other circuit. This situation is often called “like phasing.” Circuits can also be arranged so that the phase sequence for one circuit is placed adjacent to the opposite phase sequence of the other circuit. This situation is often called “unlike phasing” (or “cross-phasing,” “reverse phasing,” or “low reactance phasing”). This phasing arrangement can be applied to double (or multi-circuit) transmission and/or distribution lines, or transmission lines with a lower voltage underbuild. For magnetic field reduction, the “unlike” method works best when current flow in the adjacent circuits is equal in magnitude and direction. If the current flow in adjacent circuits is in the opposite direction, then the “like” phasing method works best for magnetic field reduction.

Of the EPMs presented in Appendix F, three would specifically apply to electrical effects: GE-17, GE-18, and GE-19. GE-17 and GE-18 relate to audible noise, radio noise, and television interference by maintaining tension on insulator assemblies, protection of the conductor surface from damage during construction, inspection and repair/replace damaged equipment, and consideration of conductor size, quantity, and bundle configurations in designing the transmission line. GE-19 relates to grounding of conductive objects within the ROW to reduce the potential for induced voltage and currents on these objects.

3.4.11.2 Impacts Associated with the Applicant Project

3.4.11.2.1 Converter Stations and AC Interconnection Siting Areas

This section describes the electrical effects associated with the two applicant proposed converter stations and the AC transmission line interconnections associated with those stations. Electrical effects would only be present during operation and maintenance of these facilities. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the project.

Existing facilities are present within these siting areas, some of which already create electrical effects within the environment. Table 3.4-14 presents the number of existing AC transmission lines that parallel proposed interconnection routes to the two converter stations as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot corridor for each proposed route alternative. Table 3.4-14 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot corridor for each siting area.

Table 3.4-14:
Occurrence of Existing Facilities within the Applicant Proposed Converter Station and AC Interconnection Siting Areas

DC Transmission Interconnection Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot Corridor (Residential/Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot Corridor (Quantity and Type)[2]
Oklahoma	1 (345kV)	0/0/0/0	0
Tennessee	0	2/6/0/0	2 (microwave towers)

1 GIS Data Source: Clean Line (2013a), Tetra Tech (2014a)
2 GIS Data Source: FCC (2012)

3.4.11.2.1.1 Construction Impacts

There are no electrical effects associated with construction of the converter stations or AC transmission lines, because these facilities would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.2.1.2 Operations and Maintenance Impacts

For the AC/DC converter stations, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the stations. Some types of substation and switching station equipment can potentially be a source of electrical effects (e.g., power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods, so the dominant sources of electrical effects are associated with the overhead transmission lines; evaluation of electrical effects for the proposed converter stations was not performed except for audible noise as described in Section 3.11.6.

3.4.11.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

No electrical effects were evaluated for the Oklahoma converter station because overhead transmission lines are the dominant sources of electrical effects near the station.

There are three different 345kV AC transmission line configurations associated with the interconnection into the Oklahoma converter station. All three line designs are double circuit configurations (i.e., two circuits supported on a single structure). One line design is a double circuit monopole, supported on a tubular pole. The other two line designs (double circuit lattice tower and double circuit danube configuration) are each supported on lattice structures. Each transmission line configuration is located within its 150-foot-wide ROW, and would primarily provide voltage support (so very little or no loading would be present on the lines). Figures 3.4-5 through 3.4-7 present dimensioned drawings of the three representative 345kV AC transmission line configurations.

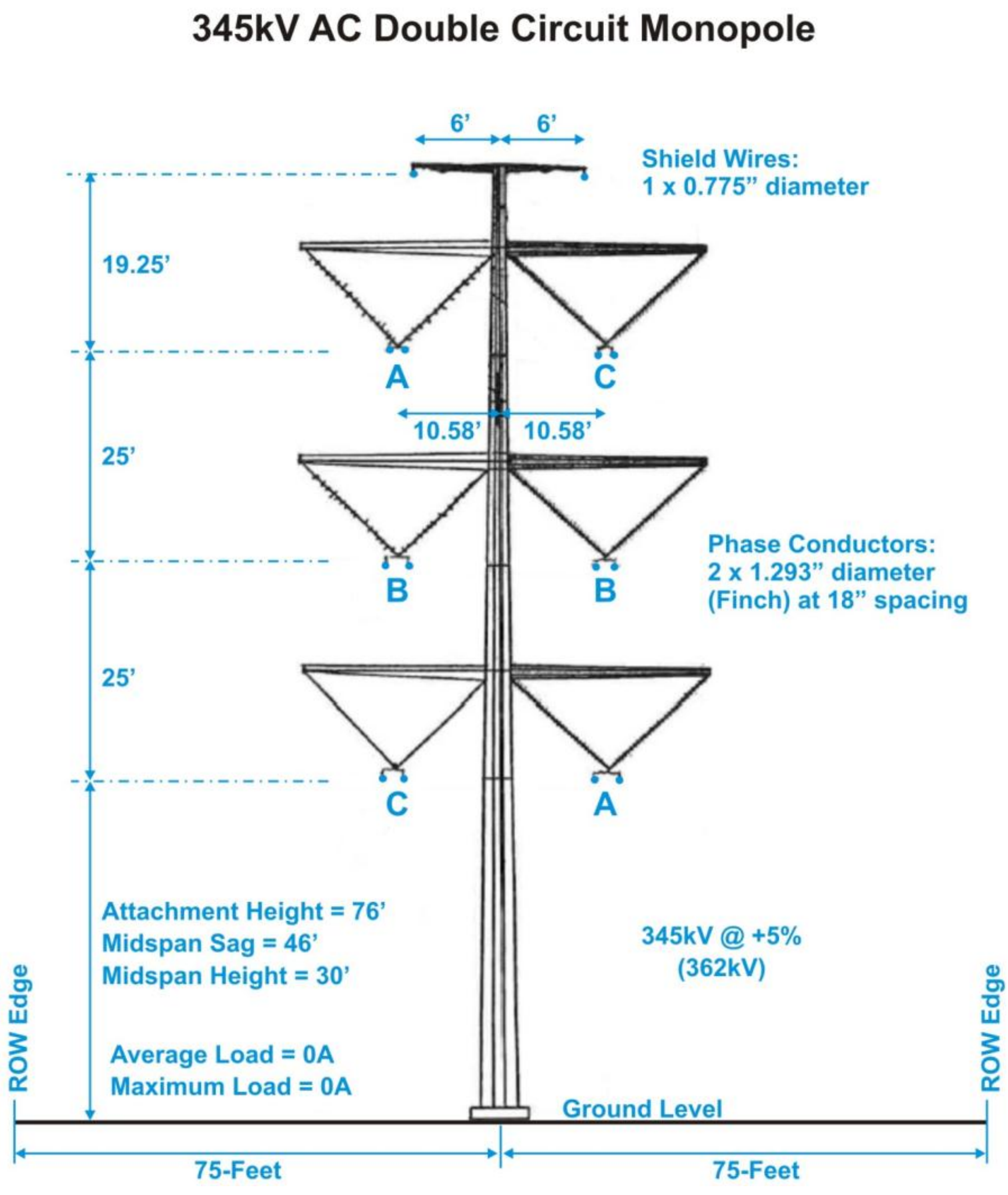
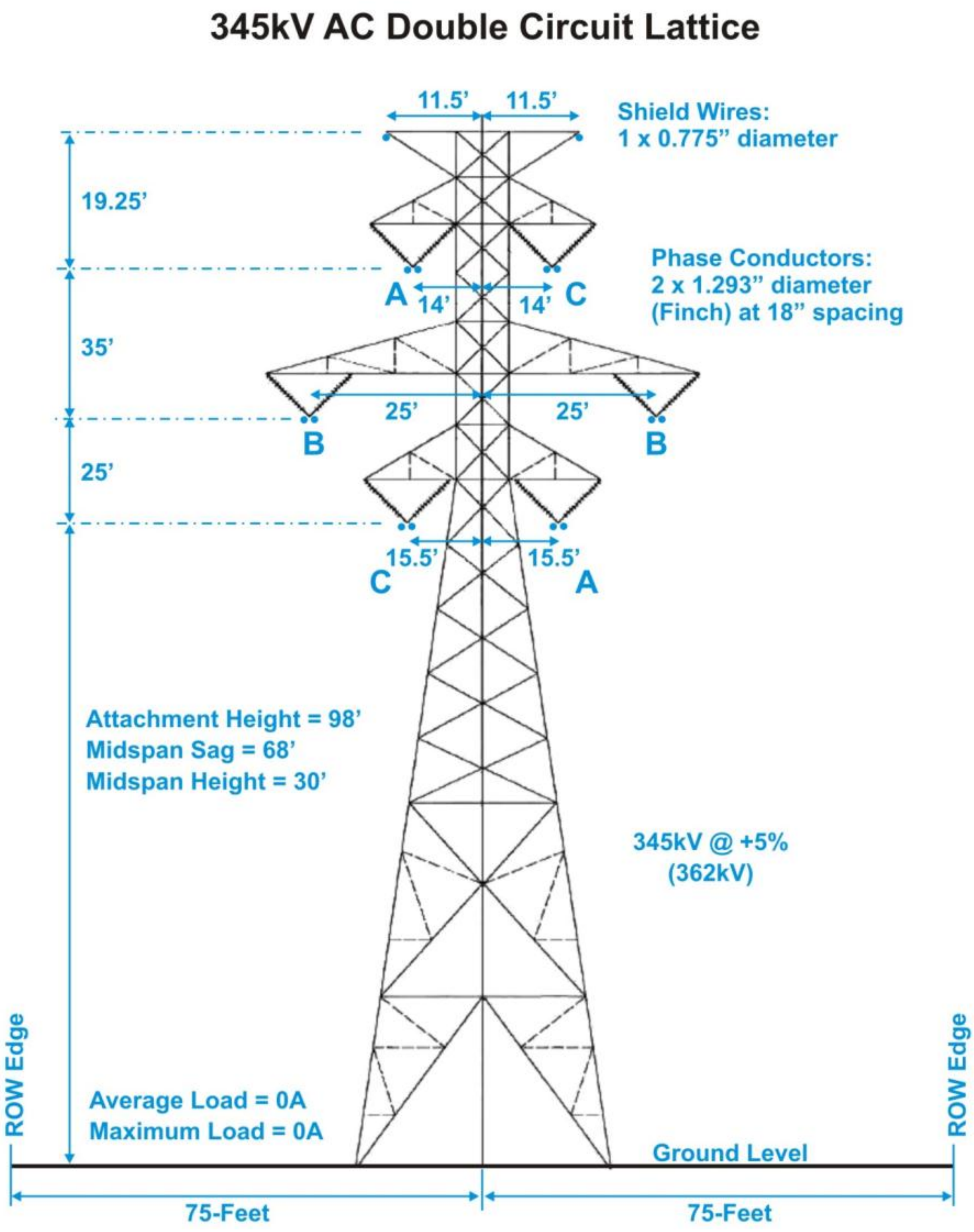


Figure 3.4-5: 345kV AC Transmission Line Double Circuit Monopole Configuration for Interconnection to Oklahoma Converter Station



1 Figure 3.4-6: 345kV AC Transmission Line Double Circuit Lattice Tower Configuration for
2 Interconnection to Oklahoma Converter Station

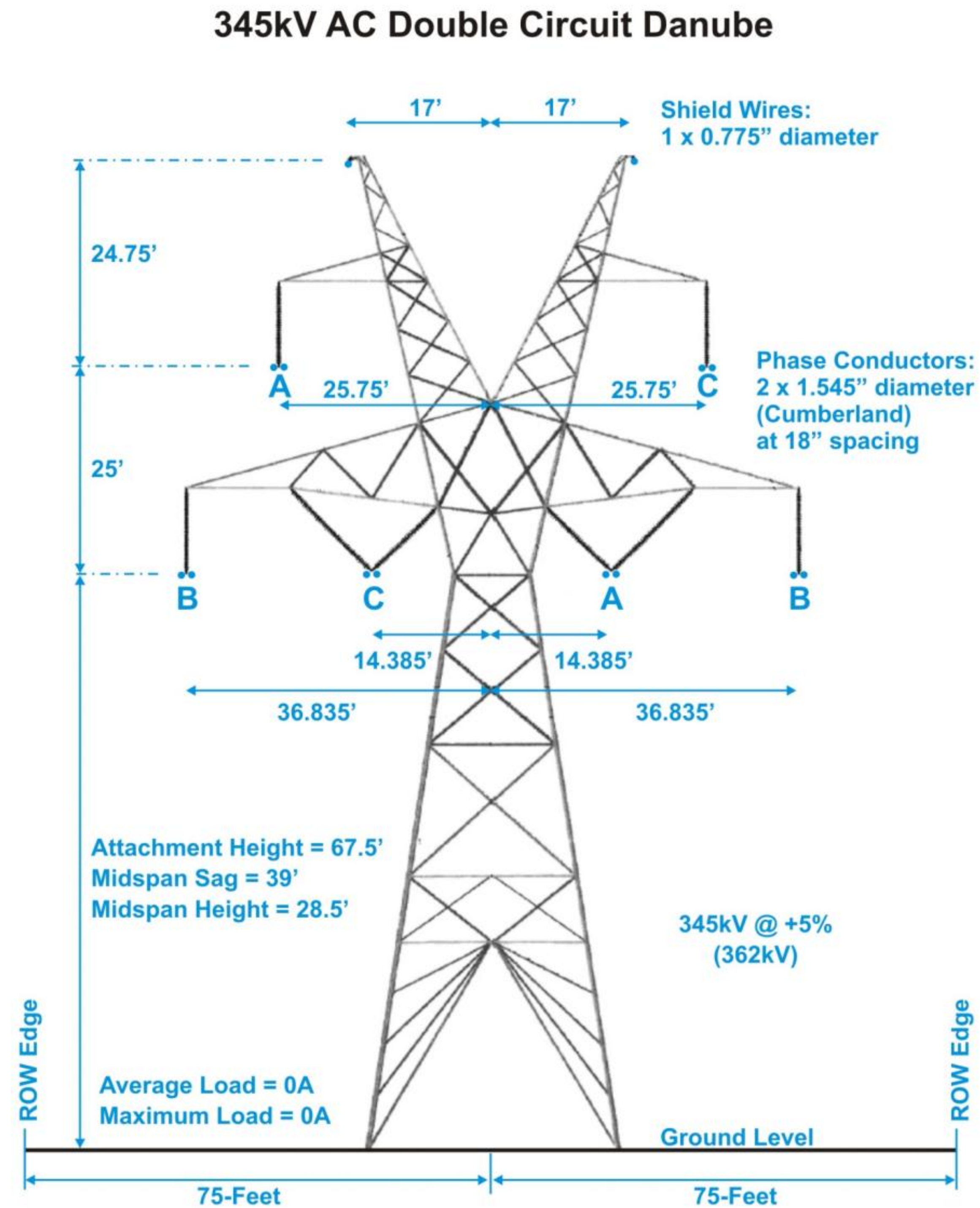


Figure 3.4-7: 345kV AC Transmission Line Double Circuit Danube Tower Configuration for Interconnection to Oklahoma Converter Station

3.4.11.2.1.2.1.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the three transmission line configurations. Table 3.4-15 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary depending upon the line configuration. Figure 3.4-8 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-15:
Calculated AC Electric Field for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)		
	ROW Edge (-75 Feet from CL)	Maximum on ROW	ROW Edge (+75 Feet from CL)
Double Circuit Monopole	0.2	4.6	0.2
Double Circuit Lattice	0.8	5.3	0.8
Double Circuit Danube	1.7	5.7	1.7

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

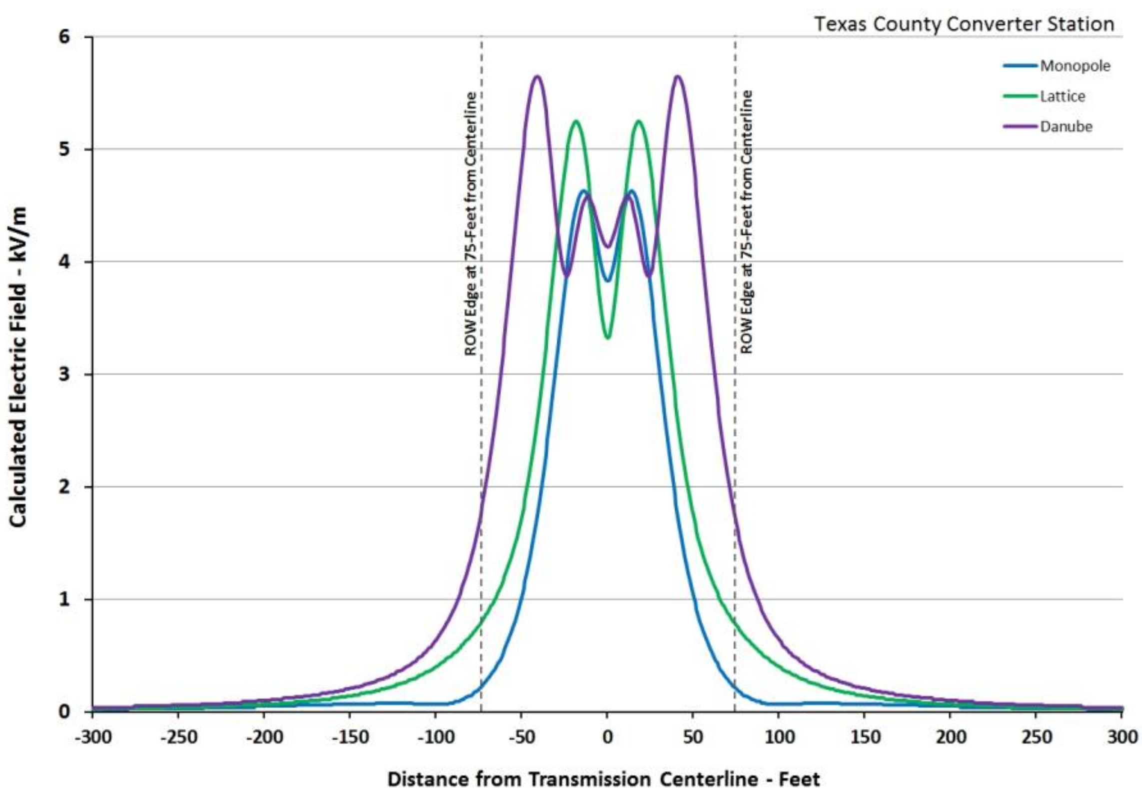


Figure 3.4-8: Calculated AC Electric Fields for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

Calculated electric field levels at the ROW edges (75 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m, respectively; see Section 3.4.6). Within the ROW, calculated electric field levels are below the ICES guideline of 10kV/m. For the double circuit Danube configuration, calculated electric field at the ROW edge (1.7kV/m) exceeds the ACGIH guideline of 1kV/m for workers with implanted medical devices.

3.4.11.2.1.2.1.2 AC Magnetic Field Calculation Results

The Applicant reported that there would not be any load on these transmission line interconnections (only voltage) (Clean Line 2014a). AC magnetic field calculations were therefore not performed for the three transmission line configurations because there was assumed to be no load on the transmission line. If no loading is present, no magnetic fields would be generated as a result of the transmission line.

3.4.11.2.1.2.1.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for the three AC transmission line configurations. Table 3.4-16 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-9 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-16:
Calculated Audible Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}		
	-75 Feet from CL	Maximum on ROW	+75 Feet from CL
Double Circuit Monopole	55.2	57.8	55.2
Double Circuit Lattice	52.2	54.2	52.2
Double Circuit Danube	51.0	53.6	51.0

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

Calculated audible noise levels at the ROW edges (75 feet from centerline of the transmission line) for two of the AC transmission line interconnections are at or below the EPA guideline for L_{dn} (day-night) noise of 55 dBA. The calculated audible noise level for the third (double circuit monopole) configuration is slightly higher than the EPA guideline (at 55.2 dBA), but calculated audible noise levels assume a 5 percent overvoltage condition at the highest line elevation (3,000 feet).

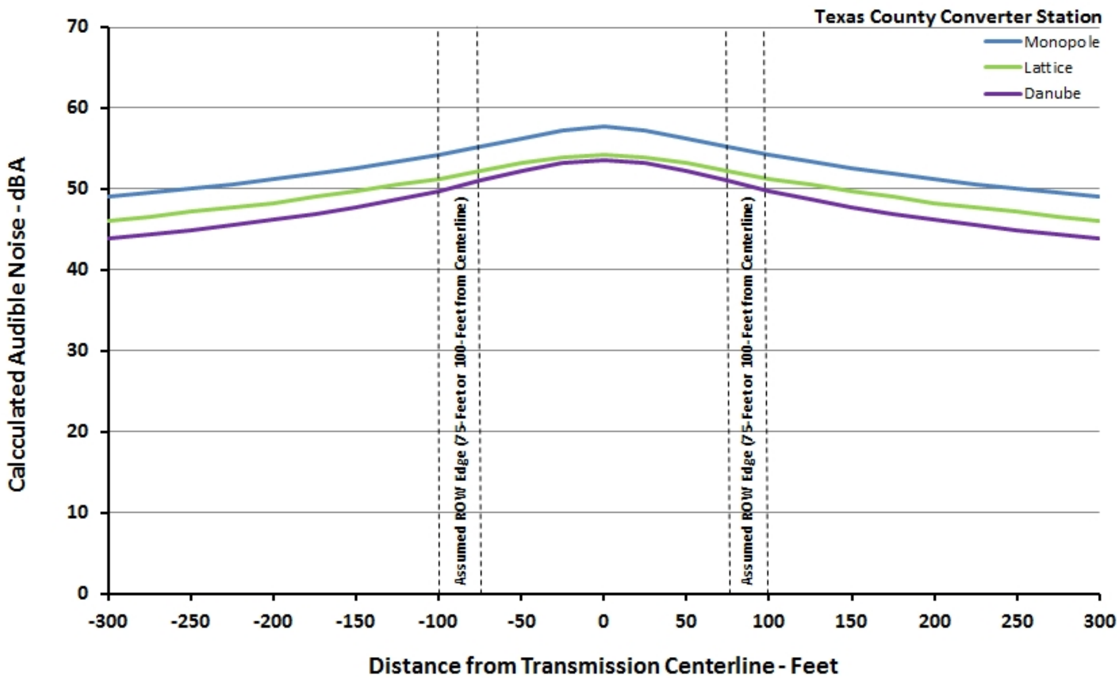


Figure 3.4-9: Calculated Audible Noise Levels (L_{dn}) for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

3.4.11.2.1.2.1.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for the three AC transmission line interconnections for rainy and fair weather conditions. Table 3.4-17 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500 kilohertz (kHz) for both weather conditions. Table 3.4-17 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-17, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold during fair weather conditions. Figure 3.4-10 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-11 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level).

Table 3.4-17:
Calculated Radio Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station at 500kHz

345kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy/Fair Weather)				
	-50 Feet from Outside Conductor	ROW Edge (-75 Feet from CL)	Maximum on ROW	ROW Edge (+75 Feet from CL)	+50 Feet from Outside Conductor
Double Circuit Monopole	67.9/50.9	66.0/49.0	82.4/65.4	66.0/49.0	67.9/50.9
Double Circuit Lattice	63.3/46.3	63.3/46.3	80.0/63.0	63.3/46.3	63.3/46.3
Double Circuit Danube	61.8/44.8	65.3/48.3	77.9/60.9	65.3/48.3	61.8/44.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

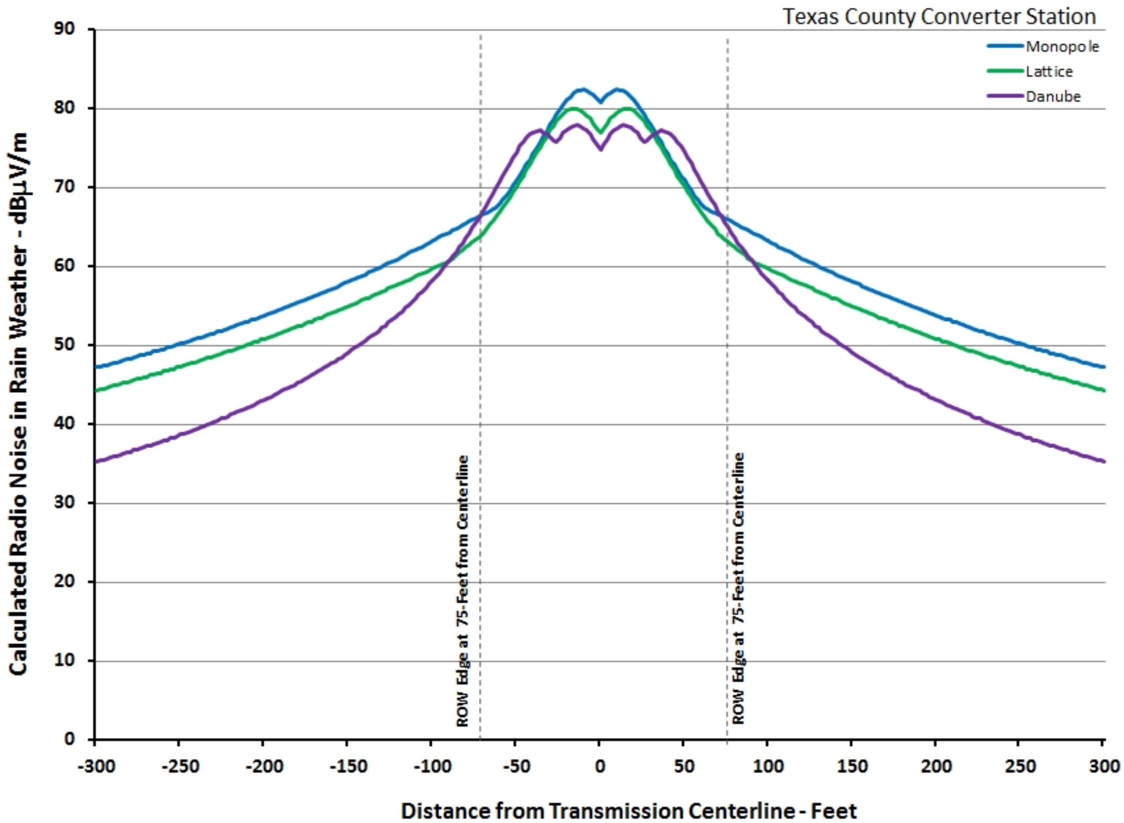


Figure 3.4-10: Calculated Radio Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station (Rainy Weather)

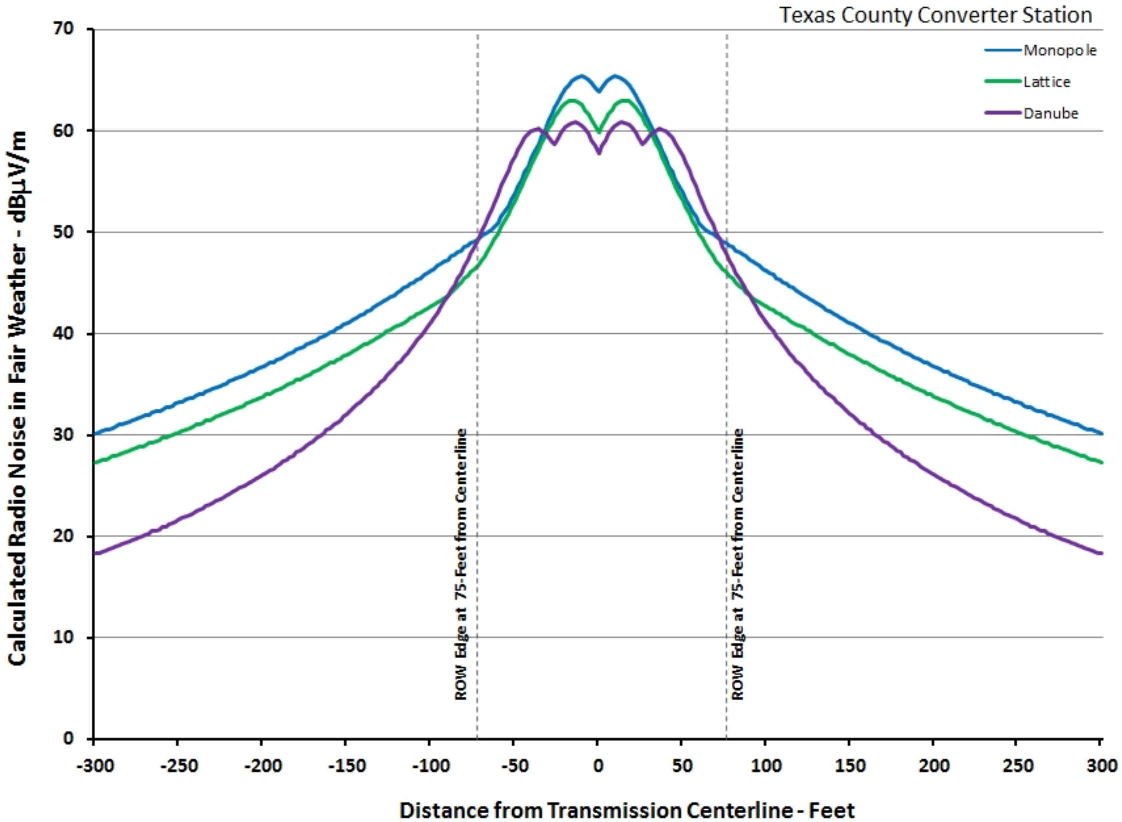


Figure 3.4-11: Calculated Radio Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station (Fair Weather)

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes. Parameters such as the strength of the received signal, the sensitivity of the receiver, the orientation and design of the receiving antenna, and ambient radio frequency noise are also important in determining the degree to which noise from any source may cause degradation of radio reception quality. Modern sources of man-made noise have grown over time and this increase has led to increasing interference in the AM broadcast band. Utilities have considerable experience in addressing complaints of interference to radio or TV reception and there are a variety of ways of mitigating interference.

For AM radio broadcasts (within 520 to 1,720kHz), coverage can be described as follows (Radio Locator 2014):

- Areas able to receive a radio station on almost any radio with moderately good to very good reception (local coverage)
- Areas where the signal of the radio station may be weak unless using a good radio or good antenna (distant coverage)
- Areas where the station signal is very weak even with a good radio and antenna, and interference may prevent reception (fringe coverage)

Radio reception from AM radio stations in fringe coverage areas may not be possible even in fair weather, regardless of the presence of radio noise sources. Reception of AM radio stations in distant coverage areas may be possible, but the potential for interference may increase near the ROW edges or within the transmission line ROW, especially during rain. Reception of AM radio stations in local coverage areas should be possible near the transmission line ROW edges, with a decreasing potential for interference with distance away from the transmission line. Rainy weather can increase interference levels.

IEEE used published listening tests of transmission line noise to create a quality-of-reception curve based upon the difference in AM radio reception quality versus the SNR—a difference between signal strength and radio noise level (previously discussed in Section 3.4.4):

- A difference of about 14 dB represents a quality of reception where background noise is very evident, but speech is easily understood
- A difference of about 20–22 dB represents a quality of reception that is fairly satisfactory but background noise is plainly evident
- A difference of about 24 dB represents a quality of reception that is very good and background noise is unobtrusive
- A difference of about 28 dB (or greater) represents an entirely satisfactory quality of reception (IEEE 1965; EPRI 2006a)

Another method for evaluating the potential for radio noise interference is based upon the IEEE Radio Noise Design Guide (IEEE 1971). This guide is intended to provide a summary of good engineering design practices that will result in a tolerable radio noise level for a proposed transmission line when placed in service. This method relates the calculated maximum surface gradient of the transmission line conductor and conductor diameter to levels of radio interference. The range of calculated maximum surface gradients for the proposed AC transmission line conductors comply with (or are less than) the established range for limiting fair weather radio noise levels in the frequency range of 150kHz to 5MHz, which includes radio broadcast frequencies.

The new digital broadcast system technology should provide improved reception and better immunity to impulse-type noise from sources such as transmission lines or vehicle ignition systems. Rather than a slowly degrading AM radio sound quality for analog systems, interference will have a threshold for performance that is essentially a go/no go proposition for digital receivers. A digital receiver can accept interference without the user noticing anything until the interference becomes so great that the reception stops. The new digital signal will be less susceptible to interference noise than an old analog signal (Smith 2004). The quality of digital reception should be better in a given noise level and would stay good beyond which the old analog reception is no longer viable. These results have been documented in previous studies, such as the FCC study (FCC 1999) that indicated that digital signals will provide improved reception and immunity to impulse noise (such as noise interference from transmission lines) than analog signals.

In 2002, the FCC selected in-band, on-channel technology as the technology AM and frequency modulation (FM) broadcasters use for digital radio broadcasting. Transition to digital radio requires broadcasters to install new equipment, and during the transition, broadcasters operate in a “hybrid” mode (broadcasting the same programming using both analog and digital signals within a single AM or FM channel). Although many stations now broadcast in digital, radio broadcasters are not required to convert to “all-digital” broadcasting at this time (FCC 2014).

FM radio stations transmit in a band of frequencies between 88MHz and 108MHz, and use a different signal modulation than AM radio which makes FM transmission immune to impulse-type noise. Transmission line corona noise, therefore, would not affect FM radio reception. FM radio is essentially a line of sight broadcast, and terrain affects FM signals.

3.4.11.2.1.2.1.5 AC Television Noise Calculation Results

Television noise calculations were performed for the three AC transmission line interconnections for rainy weather conditions. Table 3.4-18 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-12 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-18:
Calculated Television Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather		
	ROW Edge (-75 Feet from CL)	Maximum on ROW	ROW Edge (+75 Feet from CL)
Double Circuit Monopole	24.3	34.8	24.3
Double Circuit Lattice	22.5	32.4	22.5
Double Circuit Danube	22.4	30.2	22.4

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

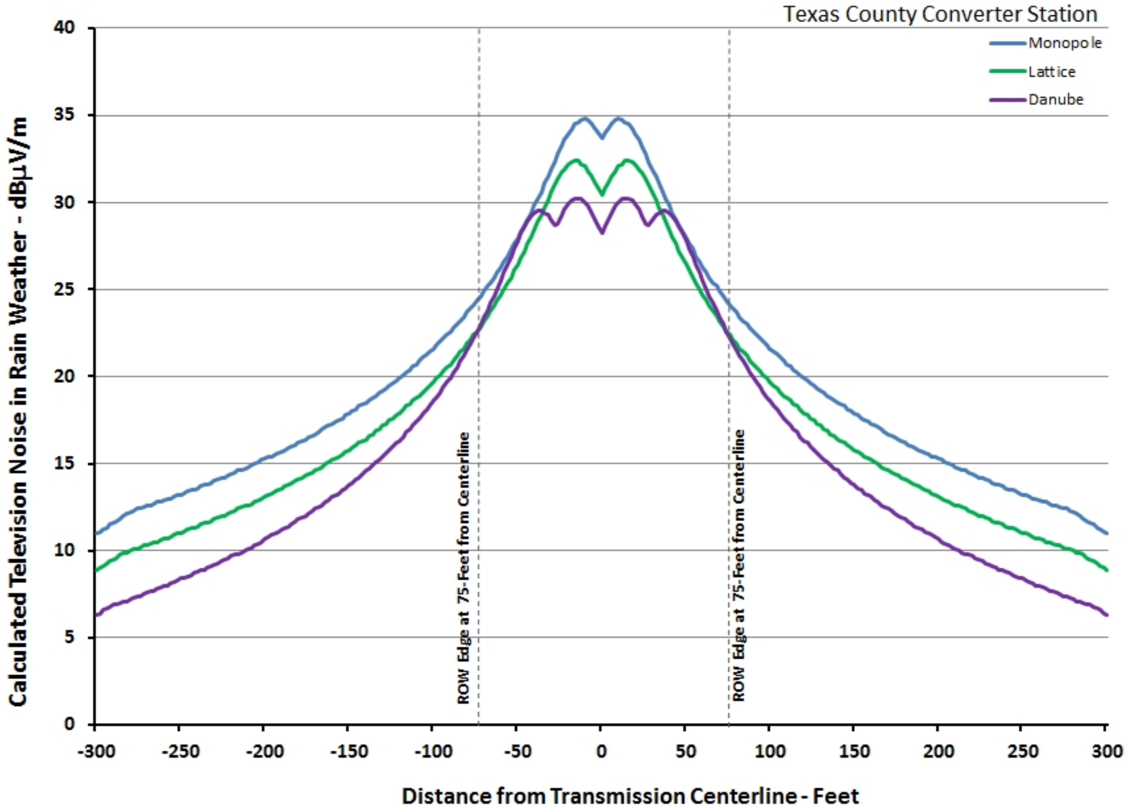


Figure 3.4-12: Calculated Television Noise for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. The new digital broadcast system technology for radio and television, however, should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a).

3.4.11.2.1.2.1.6 Ozone Calculation Results

Ozone levels for the three AC transmission line interconnections were calculated for rainy weather conditions. Table 3.4-19 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations.

Table 3.4-19:
Calculated Ozone Levels for 345kV AC Transmission Line Interconnections to Oklahoma Converter Station

345kV AC Transmission Line Configuration	Calculated Ozone (ppb) Maximum within +/-300 Feet of CL
Double Circuit Monopole	0.1
Double Circuit Lattice	0.1
Double Circuit Danube	0.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

3.4.11.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

No electrical effects were evaluated for the Tennessee converter station because overhead transmission lines are the dominant sources of electrical effects near the station.

There are two different 500kV AC transmission line configurations associated with the interconnection into the Tennessee converter station. Both line designs are double circuit configurations (i.e., two circuits supported on a single structure). One line design is a double circuit monopole and is supported on a tubular pole, while the other is a double circuit line supported on a lattice structure. Each transmission line configuration is located within a 150-foot-wide to 200-foot-wide ROW (actual ROW width has not yet been determined). Proposed loading for these lines is 1,050MW (1,212 amperes) for average loading and 1,750MW (2,021 amperes) for maximum loading. Figures 3.4-13 and 3.4.14 present dimensioned drawings of the two representative 500kV AC transmission line configurations.

3.4.11.2.1.2.2.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the two transmission line configurations. Table 3.4-20 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Because the ROW width has not yet been determined, ROW edge values are provided for both possible edge locations (either 75 feet or 100 feet from the transmission centerline). Calculated field levels vary, depending upon the line configuration. Figure 3.4-15 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-20:
Calculated AC Electric Field Values for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	0.2	0.7	8.4	0.7	0.2
Double Circuit Lattice	1.0	1.8	9.4	1.8	1.0

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

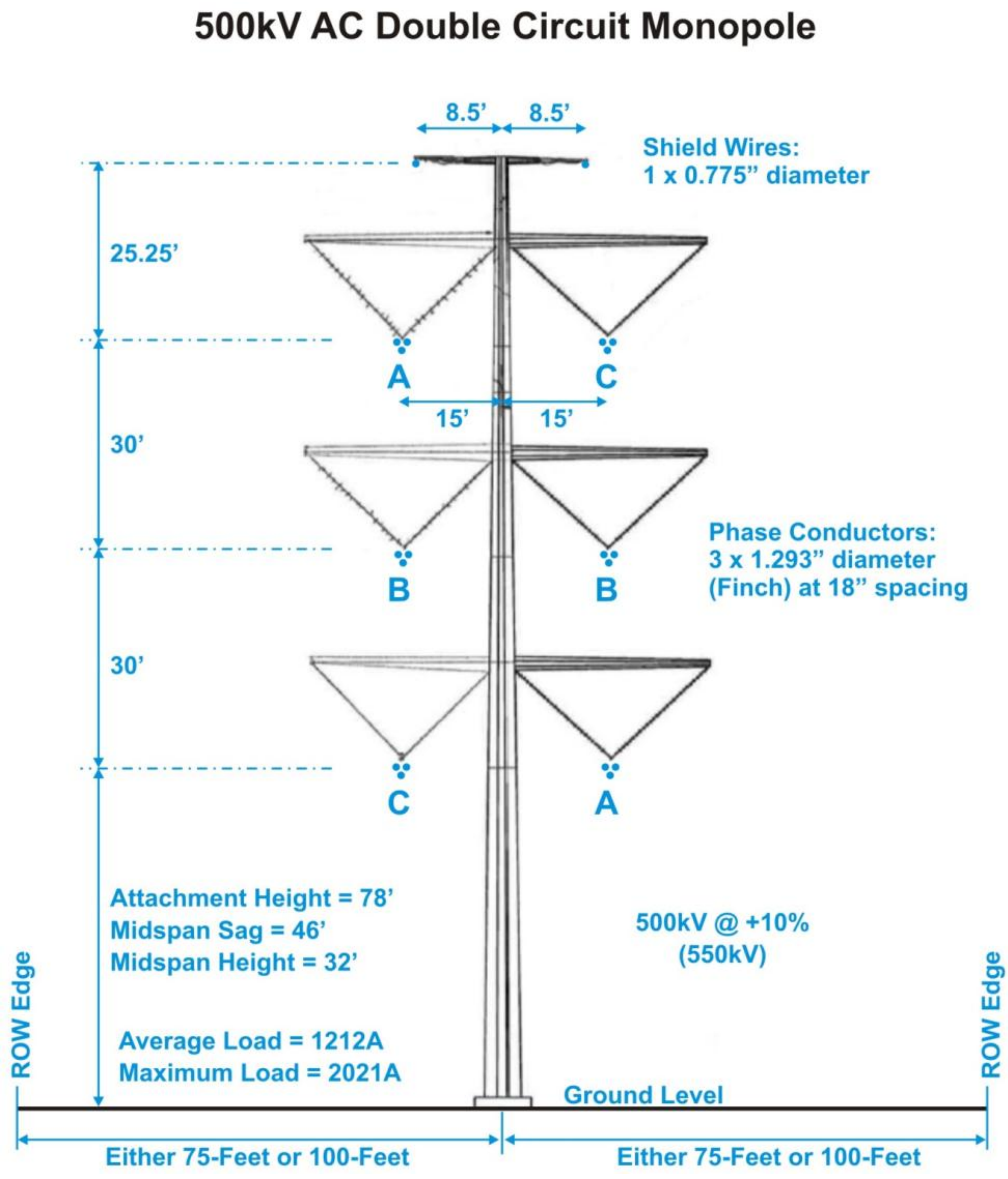


Figure 3.4-13: 500kV AC Transmission Line Double Circuit Monopole Configuration for Interconnection to Tennessee Converter Station

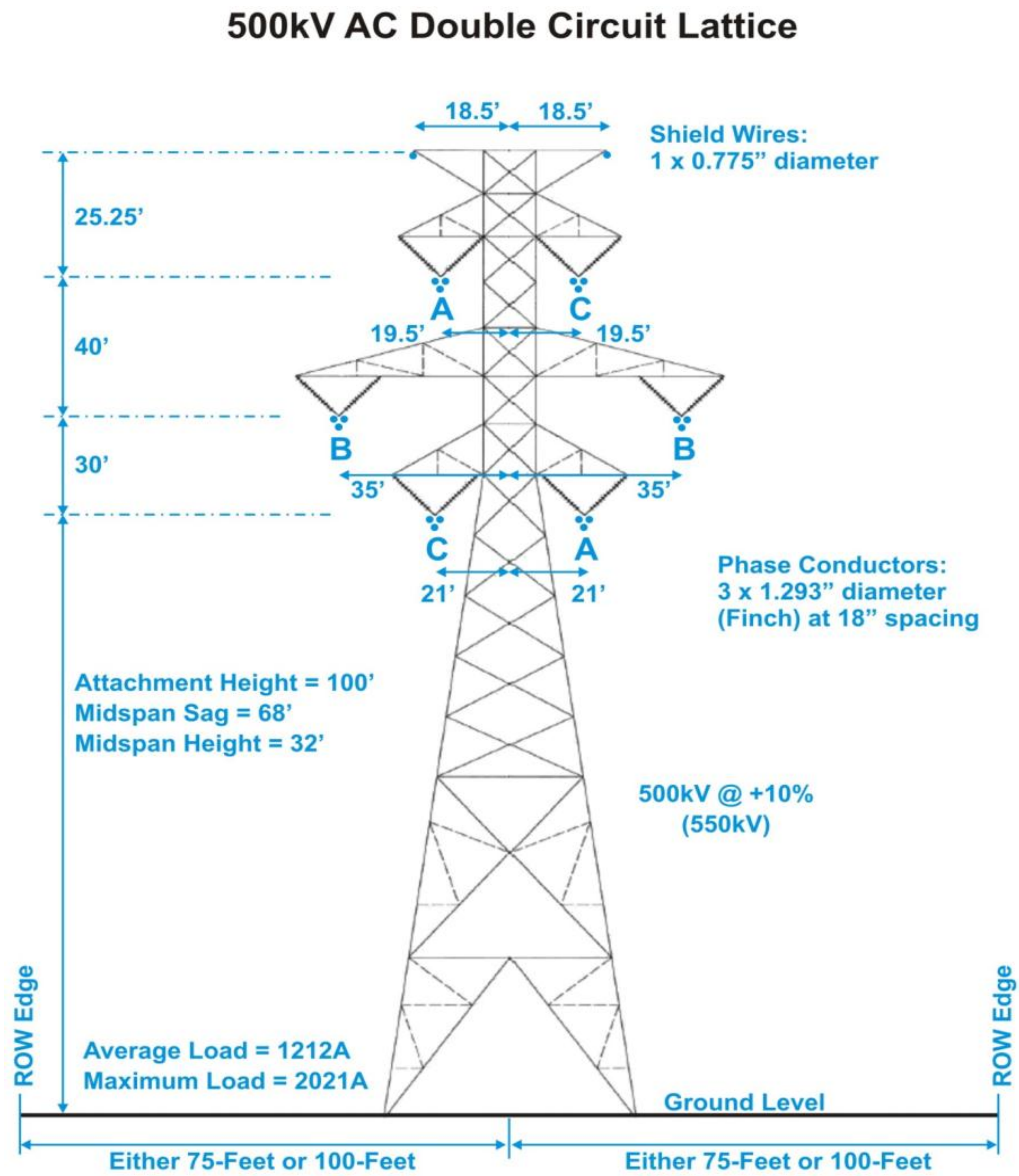


Figure 3.4-14: 500kV AC Transmission Line Double Circuit Lattice Tower Configuration for Interconnection to Tennessee Converter Station

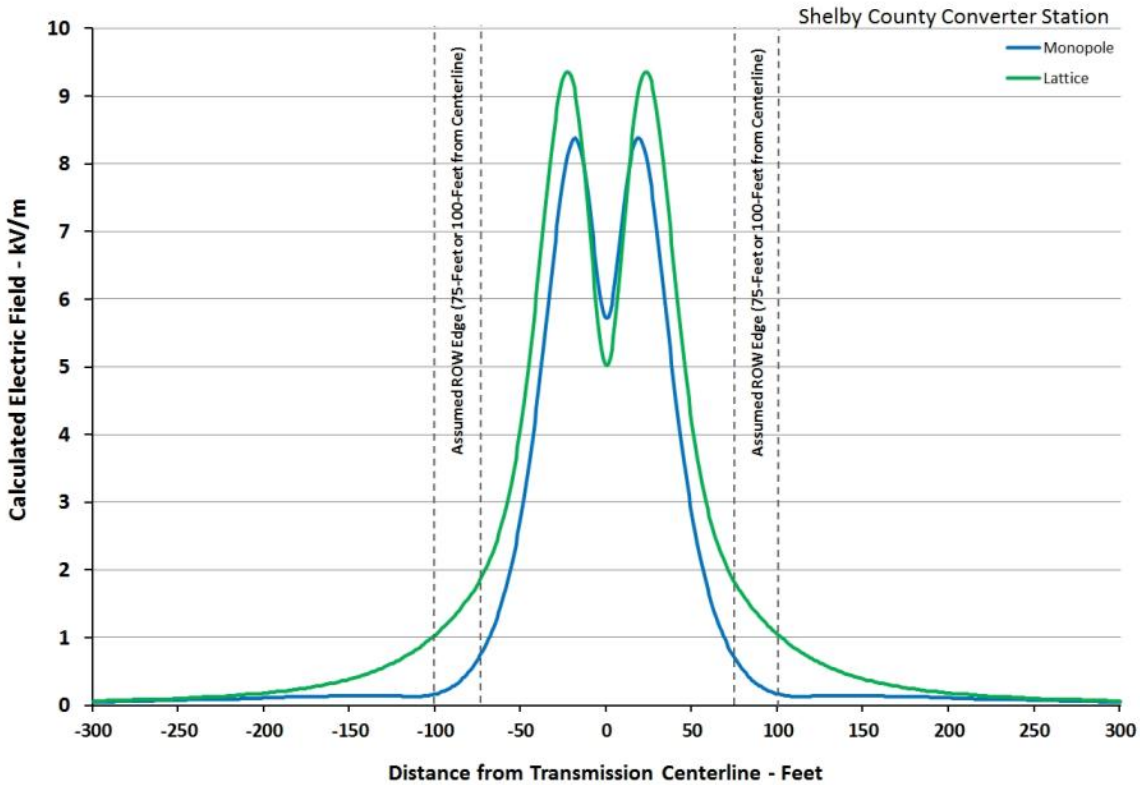


Figure 3.4-15: Calculated AC Electric Fields for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

Calculated electric field levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m respectively). Within the ROW, calculated electric field levels are below the ICES guideline of 10kV/m. For the double circuit lattice configuration, calculated electric field at the 75-foot ROW edge (1. 8kV/m) exceeds the ACGIH guideline of 1kV/m for workers with implanted medical devices, but complies at the 100-foot ROW edge.

3.4.11.2.1.2.2.2 AC Magnetic Field Calculation Results

AC magnetic field calculations were performed for the two transmission line configurations under two different loading conditions (average and maximum loading of 1212A and 2021A respectively). Table 3.4-21 presents a summary of the calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration and loading conditions. Figure 3.4-16 presents a graph of the calculated AC magnetic field for each line configuration under average and maximum loading conditions.

Table 3.4-21:
Calculated AC Magnetic Field Values for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated AC Magnetic Field (mG) for Average/Maximum Load[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	17.7/29.6	32.4/54.0	178.6/297.6	32.8/54.7	18.0/30.0
Double Circuit Lattice	29.6/49.3	52.6/87.6	210.2/350.3	53.3/88.9	30.1/50.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

Calculated magnetic field levels at the ROW edges (for either ROW width) for both AC transmission line interconnection designs are below the ICES and ICNIRP guidelines for public exposure (9,040 mG and 2,000 mG respectively). Calculated magnetic field levels within the ROW are also below the ACGIH guideline of 1,000 mG for workers with implanted medical devices for both configurations.

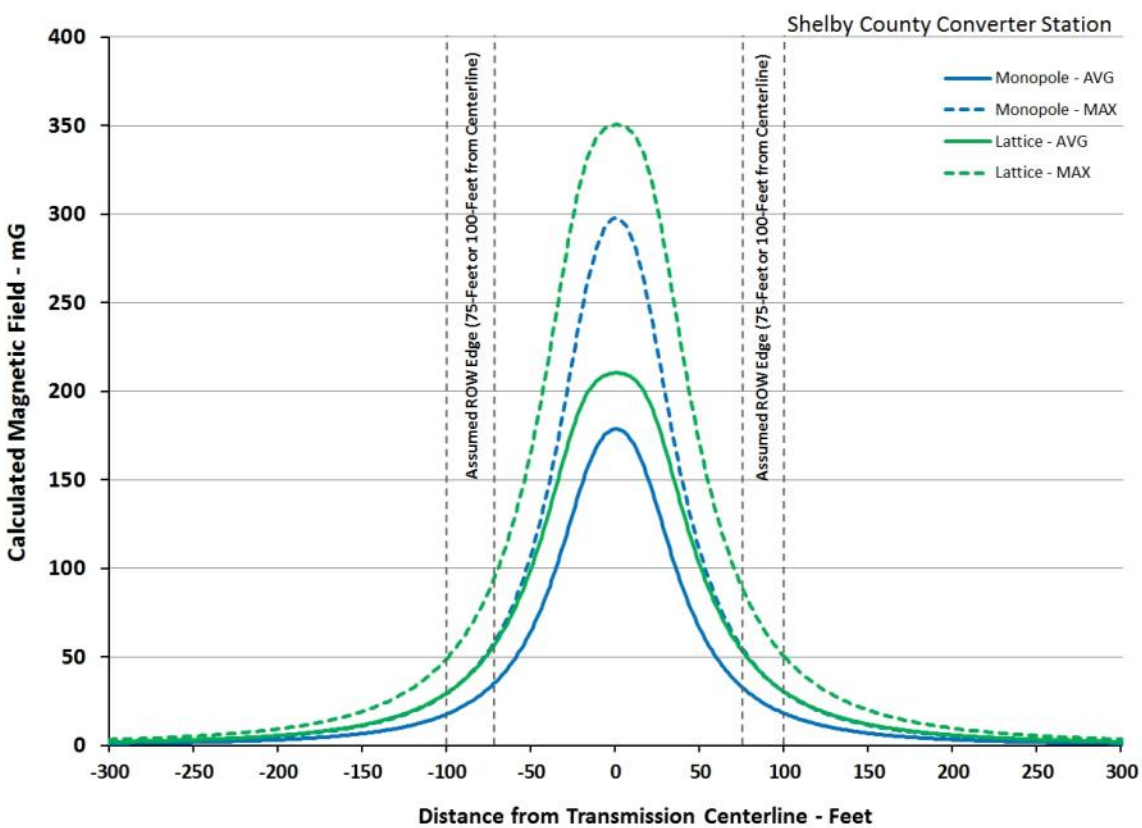


Figure 3.4-16: Calculated AC Magnetic Fields for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Average and Maximum Loading)

3.4.11.2.1.2.2.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for the three AC transmission line configurations. Table 3.4-22 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-17 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-22:
Calculated Audible Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	60.8	61.7	64.0	61.7	60.8
Double Circuit Lattice	58.1	59.0	60.7	59.0	58.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

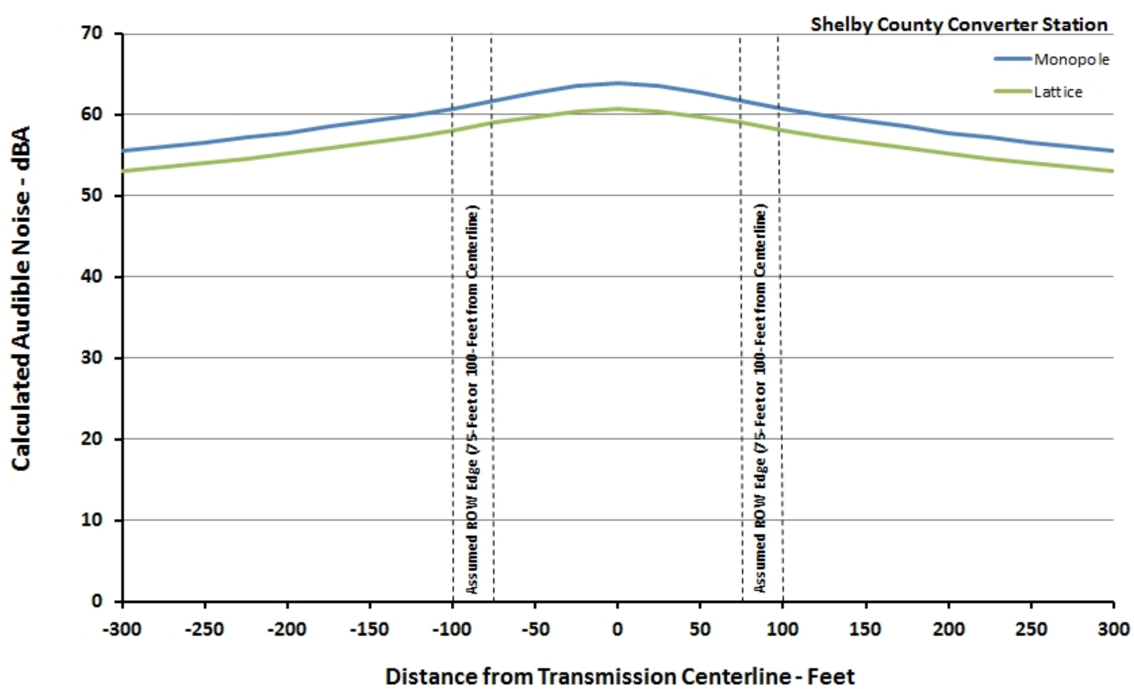


Figure 3.4-17: Calculated Audible Noise Levels (L_{dn}) for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

Calculated audible noise levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are above the EPA guideline for L_{dn} (day-night) noise of 55 dBA. Calculated audible noise levels assume a 10 percent overvoltage condition at the highest line elevation (3,000 feet).

3.4.11.2.1.2.2.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for both AC transmission line interconnection designs for rainy and fair weather conditions. Table 3.4-23 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz for both weather conditions. Table 3.4-23 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-23, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold during fair weather conditions. Figure 3.4-18 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-19 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level).

Table 3.4-23:
Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rain/Fair Weather)[1]						
	-100 Feet from CL	-50 Feet from Outside Conductor	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+50 Feet from Outside Conductor	+100 Feet from CL
Double Circuit Monopole	70.5/53.5	75.4/58.4	72.9/55.9	88.8/71.8	72.9/55.9	75.4/58.4	70.5/53.5
Double Circuit Lattice	68.8/51.8	71.1/54.1	72.5/55.5	86.4/69.4	72.5/55.5	71.1/54.1	68.8/51.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

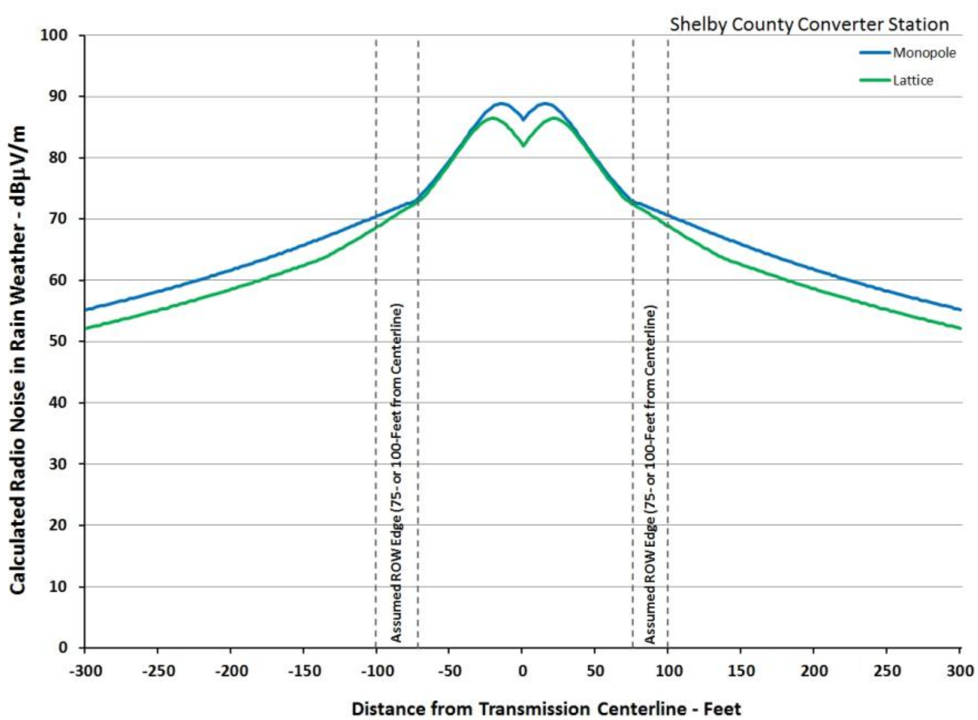


Figure 3.4-18: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Rainy Weather)

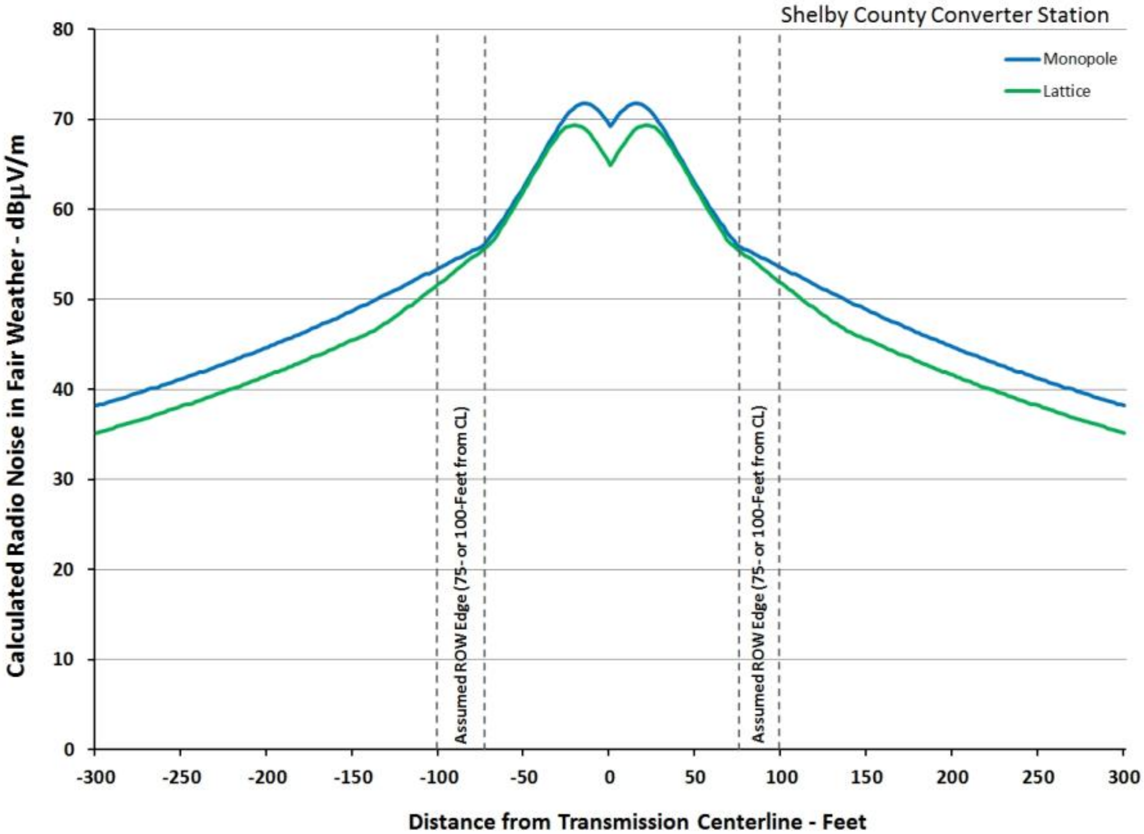


Figure 3.4-19: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Fair Weather)

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes. Parameters such as the strength of the received signal, the sensitivity of the receiver, the orientation and design of the receiving antenna, and ambient radio frequency noise are also important in determining the degree to which noise from any source may cause degradation of radio reception quality. Section 3.4.4 presents a discussion on radio noise interference and Section 3.4.6.6 on radio noise standards.

3.4.11.2.1.2.2.5 AC Television Noise Calculation Results

Television noise calculations were performed for both AC transmission line interconnections for rainy weather conditions. Table 3.4-24 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-20 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-24:
Calculated Television Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Double Circuit Monopole	29.3	32.0	41.2	32.0	29.3
Double Circuit Lattice	27.5	30.4	38.8	30.4	27.5

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline

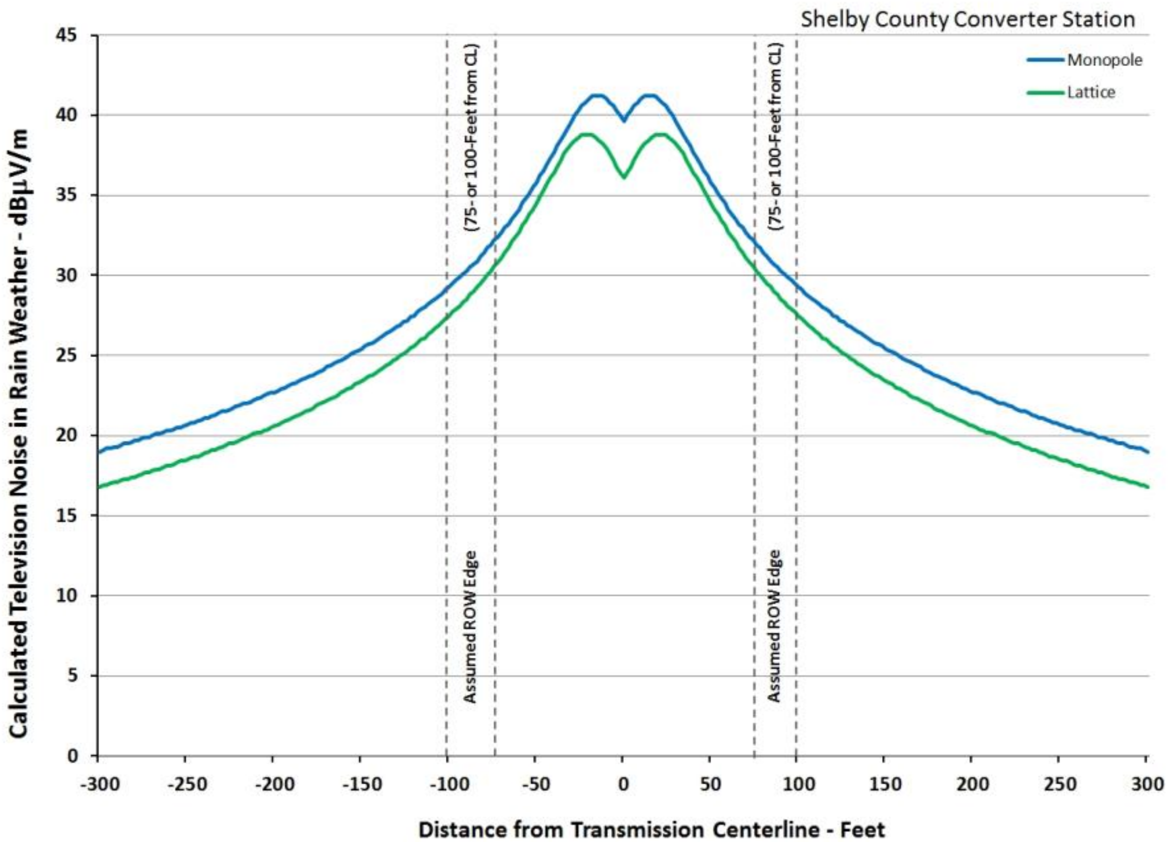


Figure 3.4-20: Calculated Television Noise for 500kV AC Transmission Line Interconnections to Tennessee Converter Station (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. However, the new digital broadcast system technology for radio and television should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a).

3.4.11.2.1.2.2.6 Ozone Calculation Results

Ozone levels for both AC transmission line interconnections were calculated for rainy weather conditions. Table 3.4-25 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations.

Table 3.4-25:
Calculated Ozone Levels for 500kV AC Transmission Line Interconnections to Tennessee Converter Station

500kV AC Transmission Line Configuration	Calculated Ozone (ppb)
	Maximum within +/-300 Feet of CL
Double Circuit Monopole	0.3
Double Circuit Lattice	0.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

3.4.11.2.1.2.2.7 Overview of AC Electrical Effects Research on Human Health

Research has been conducted in the United States and around the world to determine whether exposure to power-frequency AC electric and magnetic fields has human health effects. This research includes epidemiological studies, laboratory studies of animals and cell tissues, and multi-disciplinary reviews (or pooled analysis). Some studies have reported a statistical association between magnetic fields and health outcomes while other studies have not. The general consensus among researchers and the medical and scientific communities is that there is insufficient evidence at this time to conclude whether magnetic fields are a cause of adverse health issues or not. The National Institute of Environmental Health Sciences (NIEHS) report to the United States Congress, at the conclusion of its multi-year EMF Rapid Program, summarized its research (NIEHS and NIH 2002):

> *The NIEHS believes that the probability that ELF-EMF (extremely low frequency electric and magnetic field) exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm. The scientific evidence suggesting that extremely low frequency EMF exposures pose any health risk is weak.*

If the AC electric intensity is sufficiently large, then spark discharges due to currents induced on objects can occur. The NESC (IEEE 2007) within the United States requires that the electric field or its effects be reduced such that the largest anticipated object under a transmission line has a current to ground of no greater than 5 mA. High voltage transmission lines can induce a voltage (and therefore induce electric currents) in metallic objects such as a truck parked under the transmission line. Average adult humans can detect electric currents of about 1–2 mA. Electric currents above 5 mA can cause pain, startle response reactions, and could be harmful under certain conditions. The NESC, therefore, requires that additional ground clearance or other means shall be used to limit electric field effects to 5 mA or less.

The following discussions report on various organizations and study results concerning AC electrical effects and their conclusions:

- The International Agency for Research on Cancer (IARC) has reviewed numerous epidemiological and laboratory animal studies relevant to assess the potential for cancer causation. The epidemiology studies included residential and occupational studies of adults and children that examine the relationship between AC magnetic or electric fields and various cancers, including leukemia and brain and breast cancers. Based on its review, the IARC found limited epidemiological evidence in humans, particularly for childhood leukemia, and found that the evidence for other outcomes in adults and children, and in laboratory animals, was inadequate. A consistent relationship between adult cancer and exposure to electric or magnetic fields has not been found. Based on this evaluation of the available data, the working group classified power-frequency magnetic fields as possibly carcinogenic to humans (IARC 2002).
- The World Health Organization (WHO) published the Environmental Health Criteria 238 (EHC 238) (WHO 2007b) to address the possible health effects of exposure to AC electric and magnetic fields. The document is a thorough review of the scientific literature on the biological effects of exposure to power-frequency electric and magnetic fields to evaluate potential health risks. The Task Group was composed of international experts from several scientific disciplines and organizations involved in this area and examined epidemiological, in vitro, and in vivo studies. In its assessment of the health risk posed by AC electric and magnetic fields, the Task Group concluded that (WHO 2007b):

  Scientific evidence suggesting that every day, chronic low-intensity (above 3–4 mG) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level power-frequency magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.
- The NIEHS completed a research program to review the scientific research on health effects of power-frequency AC electric and magnetic fields. The NIEHS stated that, for most health outcomes, there is no evidence that electric and magnetic fields exposures have adverse effects. There is some evidence from epidemiology studies that exposure to power-frequency electric and magnetic field is associated with an increased risk for childhood leukemia. This association is difficult to interpret in the absence of reproducible laboratory evidence or a scientific explanation that links magnetic fields with childhood leukemia (NIEHS and NIH 2002).
- A 1997 National Cancer Institute study compared exposure to power-frequency AC magnetic fields in children with acute lymphocytic leukemia (ALL) to children who did not have the disease. No association was found between ALL and the local overhead electrical wire configuration (wire code) at the residences occupied by the children before they had cancer. The investigators found a statistical association between leukemia and magnetic field levels in the 4.0–4.99 mG exposure category, but not for time weighted average exposures less than 4 mG or for exposures greater than or equal to 5 mG (Linet et al. 1997). Currently, the National Cancer Institute website states: “Overall, there is limited evidence that magnetic fields cause childhood leukemia, and there is inadequate evidence that these magnetic fields cause other cancers in children. Studies of magnetic field exposure from power lines and electric blankets in adults show little evidence of an association with leukemia, brain tumors, or breast cancer. Past studies of occupational magnetic field exposure in adults showed very small increases in leukemia and brain tumors. However, more recent well-conducted studies have shown inconsistent associations with leukemia, brain tumors, and breast cancer” (NCI 2014).

- The National Radiological Protection Board (NRPB; now a part of Public Health England as of April 2013) was a United Kingdom public body set up to disseminate information about the protection of mankind from radiation hazards. The NRPB later became the Advisory Group on Non-ionizing Radiation (AGNIR). The AGNIR performed an assessment of the scientific literature on potential effects of AC electric and magnetic field assessment on the information available from experimental studies on tissues, living cells and animals, and human volunteer and epidemiological studies. The AGNIR concluded that laboratory experiments have provided no good evidence that power-frequency electric and magnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general. There is however some epidemiological evidence that prolonged exposure to higher levels of power-frequency magnetic field is associated with a small risk of leukemia in children. In practice, such levels of exposure are seldom encountered by the general public in the United Kingdom. In the absence of clear evidence of a carcinogenic effect in adults, or of a plausible explanation from experiments on animals or isolated cells, the epidemiological evidence is currently not strong enough to justify the firm conclusion that such fields cause leukemia in children. Unless further research indicates that the finding is due to chance or some currently unrecognized artifact, the possibility remains that intense and prolonged exposures to magnetic fields can increase the risk of leukemia in children (NRPB 2004a, 2004b).
- A United Kingdom Childhood Cancer Study (UKCCS) reported on power-frequency AC magnetic field measurements that included a portion of the cases and controls evaluated in a previous study in the United Kingdom. Magnetic field exposures were assessed for 1,331 ALL cases. The results of the UKCCS study showed no evidence for an association with leukemia for magnetic fields calculated to be between 1 mG–2 mG, 2 mG–4 mG, or 4 mG or greater at the residence. This result agrees with UKCCS' earlier report in which magnetic field exposure was estimated by measurement. Children with leukemia were not more likely to live near high-voltage distribution and transmission lines or substations than control children (UKCCSI 1999, 2000).
- Two pooled analyses were performed in 2000 on data from previous epidemiology studies of power-frequency AC magnetic fields and childhood leukemia (Ahlbom et al. 2000; Greenland et al. 2000). The pooled data created a much larger number of subjects and therefore provided greater statistical power than any individual study taken alone. One pooled analysis combined nine studies: five with measurements of magnetic fields in the child's home, and four that estimated residential magnetic field exposures from calculations. The other pooled analysis used 12 studies, 8 of which were the same as used by the other pooled analysis but did not include the large 1999 United Kingdom Childhood Cancer Study. Both studies included the National Cancer Institute study and both studies examined ALL as well as other forms of leukemia. Neither of these pooled studies included the 2000 data from the large UKCCS study. The pooled analysis found that there was no indication that the local overhead electrical wire configurations (wire codes) are more strongly associated with leukemia than measured magnetic fields, that there was an absence of an association between childhood leukemia and magnetic fields for exposures below 3 mG, but that pooling these data results in a statistical association with leukemia for exposures greater than 3–4 mG.

This section is not a comprehensive review of the entire body of evidence, and excludes consideration of many other relevant published scientific studies. Scientific research utilizes epidemiology studies, animal models, and laboratory studies of basic mechanisms to scientifically evaluate a disease risk. Based upon a comprehensive review of the scientific literature, the association between AC magnetic fields and adverse health effects is weak and research is continuing. In 2002, the U.S. DOE concluded that "For most health outcomes, there is no evidence that EMF exposures have adverse effects. There is some evidence from epidemiological studies that exposure to power-frequency EMF is associated with an increased risk for childhood leukemia. This association is difficult to interpret in the absence of reproducible laboratory evidence or a scientific explanation that links magnetic fields with childhood leukemia" (NIEHS and NIH 2002). The current assessment of the research by the WHO concluded "that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields (WHO 2014)." And "the Task Group concluded that there are no substantive health issues related to ELF electric fields at levels generally encountered by members of the public." (WHO 2007a)

3.4.11.2.1.2.2.8 Overview of AC Electrical Effects Research on Pacemakers and Implanted Medical Devices

Public concern has been expressed related to the electric and magnetic fields of transmission lines with the possibility of interference with cardiac pacemakers. When pacemakers detect a spurious signal, such as an induced 60Hz current, they can change from a synchronous mode of operation to an asynchronous or fixed pacing mode of operation and then return to a synchronous mode of operation within a specified time after the signal is no longer detected. The issue is whether transmission line fields could adversely affect the pacemaker's operational mode and the resulting effect it could have on users.

For AC electric and magnetic fields, studies have determined thresholds for interference of the most sensitive units to be about 2,000 to 12,000 mG for magnetic fields and about 1.5 to 2.0kV/m for electric fields. Guidelines for occupational exposure suggest that AC electric field exposure should not exceed 1kV/m or 1 G for AC magnetic fields for workers with cardiac pacemakers (ACGIH 2010). It is unclear that reversion to a fixed pacing mode is harmful because pacemakers are routinely put into reversion with a magnet to test operation and battery life. Some new pacemaker models are dual chamber devices with different types of sensing leads that can be more sensitive to external interference. Some of these units may experience interference in AC electric fields as low as 1.2 to 2kV/m, while other models appear unaffected in fields up to almost 10kV/m (EPRI 2013a). One study specifically looked at pacemaker interference under a 400kV AC transmission line (Korpinen et al. 2012). One disturbance was noted (a unipolar pacemaker) out of the 31 different types of pacemakers tested (in an electric field of 6.7–7.5kV/m and magnetic field of 24–29 mG). The pacemaker disturbance set the pace to 60 times per minute, and when the same pacemaker was configured with a bipolar lead, no disturbance was observed. The study concluded that the risk of disturbance was not deemed to be high.

The American Heart Association website lists devices with risk for pacemakers (AHA 2012), including anti-theft systems, security metal detectors, cell phones, MP3 players, and welding equipment. However, AC transmission lines are not included in the list. For implantable cardioverter defibrillators, the American Heart Association website lists low voltage power lines (typical in residential areas) as devices with little or no risk to implantable cardioverter defibrillators (ICDs) (AHA 2013).

The biological consequences of brief reversible pacemaker malfunction are mostly benign (typically the implanted device will resume a normal mode of operation if the patient moves away from the source of the interference) (Medtronics 2013; Korpinen et al. 2012). An exception would be an individual who has a sensitive pacer and is completely dependent on it for maintaining all cardiac rhythms. For such an individual, a malfunction that compromised pacemaker output or prevented the unit from reverting to the fixed pacing mode, even brief periods of interference, could be life-threatening. The precise coincidence of events (i.e., pacer model, field characteristics, and biological need for full function pacing) would generally appear to be a rare event.

The European Committee for Electrotechnical Standardization (CENELEC) recently developed specific procedures to assess potential risks to workers with active implantable medical devices (CENELEC 2010). CENELEC has determined that these devices are expected to function without interference below a reference level of 1,000 mG at 50 Hz for magnetic fields (833 mG at 60 Hz, the frequency of the electric power system in the United States).

While a variety of electronic devices are known to affect the operation of pacemakers and other implanted medical devices, transmission lines have not been reported as a significant source to produce functional disturbances to these devices. There is a possibility that induced potentials on the leads of these devices by AC electric fields on the ROW could affect the operation of these devices, but the clinical significance of such changes appears small. Patients with implanted medical devices should observe certain precautions and need to discuss their treatment with their doctor or physician. In addition, there are a variety of different medical devices which are constantly evolving and changing. It is also impossible to quantify all of the various types of magnetic field sources encountered in people's day-to-day lives. The potential for interference to implanted devices may depend upon a variety of different parameters, including the device manufacturer, model and setting, and implantation method, among other factors. Typically implanted medical devices are set specifically for an individual by their doctor or physician within the doctor's office or medical facility. As with any implanted medical device, the user should always consult with their doctor and the device manufacturer to determine safe operational parameters for use of their specific medical device and associated medical condition.

3.4.11.2.1.2.2.9 Overview of AC Electrical Effects Research on Plant and Animal Health

Research has been conducted to determine whether exposure to power-frequency AC electric and magnetic fields has environmental effects on plant or animal life. Numerous studies have examined the effect of power-frequency electric and magnetic field exposure on plant species, both forest and agricultural. For trees located near very high voltage transmission lines (above 1,200kV), needle burn occurred on trees within 100 feet of the transmission lines (these 1,200kV lines are much higher in voltage than the 345kV and 500kV lines associated with the Project). Other studies of seed germination, seedling growth, seed production, and biomass found no adverse effects due to AC electric and magnetic field exposure. Results from studies on some groups of animals did not report any effect due to electric or magnetic fields, while other studies found mixed results, with some studies indicating an effect due to electric or magnetic fields while others did not. These results were therefore inconsistent and inconclusive.

The following discussions report on various study results concerning electrical effects and their conclusions:

- Numerous studies have examined the effect of AC electric and magnetic field exposure on plant species, both forest and agricultural. Needle burn occurred on trees within 100 feet of very high voltage (above 1,200kV) transmission lines (Rogers et al. 1984). Other studies of seed germination, seedling growth, seed production, and biomass found no adverse effects due to AC electric and magnetic field exposure (Lee et al. 1996).
- The National Grid website presents the results on farm crop studies and AC transmission lines reviewed during a 1991 study (National Grid 2014b). Seven studies had findings of either no effects (five studies) or low yields and reduced germination rates in a minority of the tests (two studies). Similar effects were also reported for electric and magnetic fields and farm animals. Of eight studies, six studies reported no effects, one study reported no major effects (but various minor effects), and one study reported some effects (National Grid 2014a). Overall, the majority of these studies found that generally there were no effects on crops or animals.
- Because of the shielding effects of trees, shrubs, grass, and the soil, ground-dwelling and underground species are largely shielded from AC electric fields under transmission lines (Deno and Silva 1987). Larger species of

animals such as deer, elk, and domestic animals have greater potential exposure to electric fields. Magnetic field exposure is unaffected by these shielding factors and all plant and animal species would experience greater exposure in the vicinity of transmission lines.

- Domestic animals grazing near transmission lines are subject to potentially higher levels of AC electric and magnetic field exposure than large game species. Two studies (Algers and Hennichs 1985; Algers and Hultgren 1987) compared the reproductive functions of pregnant cows exposed to 50Hz AC fields with unexposed animals and found no effect. Two studies (Goodwin 1975; Picton et al. 1985) monitored the behavior of big game species near a 500kV transmission line. Neither study found any effect due to AC electric or magnetic fields. However, transmission lines with a voltage above 110kV can produce audible noise, especially in periods of inclement weather. The presence of audible noise could have altered behavior and introduced a possible confounding factor in these studies.
- AC electric and magnetic field effects on cellular functions in sheep, in particular immune response, have also been examined (Hefeneider et al. 2001). In a previously unpublished report, these researchers noted differences in the production of leukocyte proteins between exposed and control groups. In a replicated effort, sheep were subjected to much longer periods of electric and magnetic field exposure but found no evidence of differences in immune response.
- A study of cows in Quebec reported that EMF caused a biological response in dairy cows that affected milk fat percentage, dry matter intake, and blood progesterone. No indications of health hazards to dairy cattle were found by the exposure to 10kV/m AC electric fields and 300 mG AC magnetic fields. Nevertheless, the strong association between these changes and the EMF warrants further research (Burchard et al.1996).
- Avian species are exposed to AC electric and magnetic field during flybys of transmission lines and nesting or roosting in their vicinity. A study by Fernie et al. (2000) reported that continuous AC electric and magnetic field exposure reduced hatching and fledging success, reduced embryonic development, and increased egg size. These researchers also found effects of continuous, extended electric and magnetic field exposure on the body mass and food intake of reproducing falcons and altered melatonin levels in male falcons. However, another study of embryonic development (Beaver et al. 1994) showed no adverse impacts of magnetic field exposure. After a review of AC electric and magnetic field from transmission lines and avian species, another study (Fernie and Reynolds 2005) concluded that electric and magnetic field can affect birds but the results are not consistent or even in a consistent direction.
- Research on AC electric and magnetic field and melatonin levels in seasonal breeding species has produced inconsistent results (Wilson et al. 1981; Holmberg 1995; Kroeker et al. 1996; Vollrath et al. 1997; and Huuskonen et al. 2001). An examination of sheep and cattle exposed to electric and magnetic field from transmissions lines above 500kV showed no effect on hormone melatonin levels (Stormshak et al. 1992; Lee et al. 1993, 1995; Thompson et al. 1995; Burchard et al. 1998, 2004).
- Beehives exposed to AC electric fields of 7kV/m compared to unexposed hives were found to have adverse effects on the colonies including decreased hive weight, increased mortality, loss of the queen, and a decrease in the hive’s survival (Greenberg et al. 1981). These effects were caused by induced currents and micro-shocks from the electric field, and eliminated by shielding the hive, using hives without metallic parts, or placing the hive farther away from the transmission line.
- A study of native bees was performed near high voltage AC transmission lines in Maryland, Wisconsin, and Oregon. The study evaluated larval development, floral visitation, pollination, species’ diversity and abundance. No indication of negative impacts of EMF was found in any of the study areas and there continues to be no

credible evidence that native bee species are harmed by EMF in terms of foraging, nesting, or behavior (Russell et al. 2013).

- A study on cattle and deer herds reported that the animals preferentially aligned themselves along the geomagnetic axis (Begall et al. 2008). Satellite images were used to obtain alignment data for herds over various regions of the earth. A second study from the same research team (Burda et al. 2009) reported this alignment was not observed for herds near AC transmission lines. However, an independent research group (Hert et al. 2011) was unable to confirm the results using the same satellite-based images. Two different statistical evaluation methods (one evaluation method tried to replicate the original study and the second tried an improved method) did not replicate the same findings.

Several laboratory and field studies have investigated the potential effect of electric and magnetic fields from transmission lines on plants, such as agricultural crops, trees, and forest and woodland vegetation. No adverse biological effects were consistently observed, and none have been confirmed at exposure at levels similar to those of the Project. Other research on the health, behavior, or productivity of animals, including livestock (e.g., dairy cows, sheep, and pigs) and a variety of other species (e.g., small mammals, deer, elk, birds, and bees) has not identified any reliable effects at the field levels associated with the Project. This section was intended to provide a review of many of the relevant scientific studies which have been published and is not meant to be a comprehensive review of the entire body of evidence (many other scientific studies have been performed). Based upon a comprehensive review of the scientific literature, the association between AC magnetic fields and adverse effects to plant life and animal health is weak.

3.4.11.2.1.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of the converter stations or the AC overhead transmission interconnection lines. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.2.2 AC Collection System

This section describes the electrical effects associated with AC transmission line collection system in Oklahoma and Texas. Electrical effects would only be present during operations and maintenance of these facilities. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the Project.

Existing facilities are present along many of the AC collection system routes, some of which already create electrical effects within the environment. Table 3.4-26 presents the number of existing AC transmission lines that parallel the AC collection system routes as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot corridor for each proposed route alternative. Table 3.4-26 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot corridor for each route.

Table 3.4-26:
Occurrence of Existing Facilities along Proposed AC Collection System Routes

AC Collection System Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot Corridor (Residential/ Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot Corridor (Quantity and Type)[2]
E-1	1 (115kV)	193/207/1/2	3 (CT, AS)
E-2	2 (345kV)	19/73/0/0	0
E-3	0	39/162/0/0	5 (MT, PM, AS)
NE-1	0	48/376/0/0	5 (PM, AS)
NE-2	1 (345kV)	24/180/0/0	13 (MT, PM, CM, FM, AS)
NW-1	4 (69-115kV)	25/84/0/0	18 (MT, PM, CT)
NW-2	0	44/259/0/0	5 (PM, AS)
SE-1	2 (345kV)	7/26/0/0	0
SE-2	3 (115-345kV)	10/24/0/0	0
SE-3	2 (345kV)	19/71/0/0	2 (PM)
SW-1	2 (345kV)	8/14/0/0	0
SW-2	2 (115kV)	10/31/0/0	0
W-1	1 (115kV)	5/21/0/0	0

PM—Private Land Mobile, MT—Microwave Tower, AS—Antenna Structure, CM—Commercial Land Mobile, CT—Cellular Tower, FM—FM Radio

1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a)

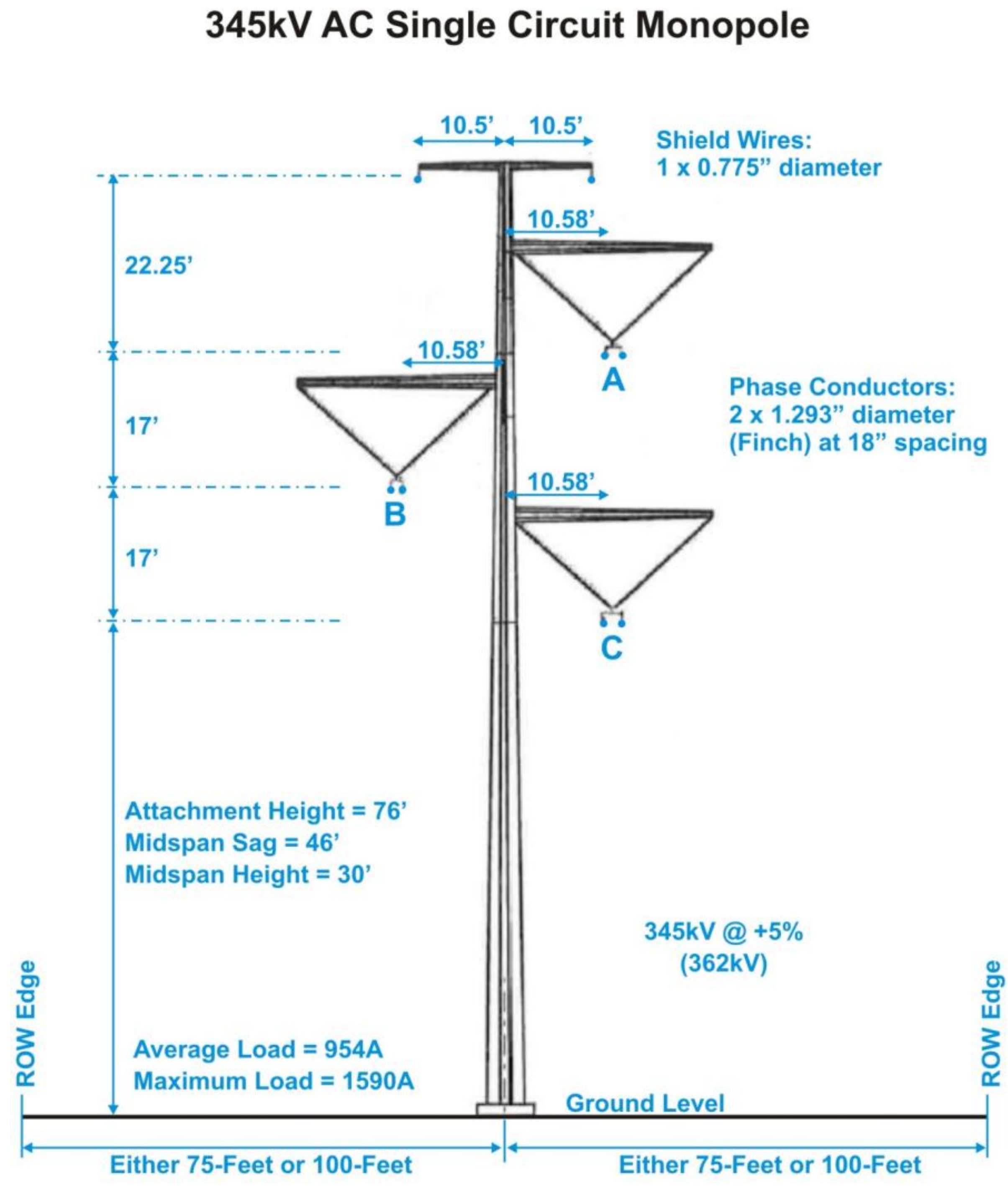
2 GIS Data Source: FCC (2012)

3.4.11.2.2.1 Construction Impacts

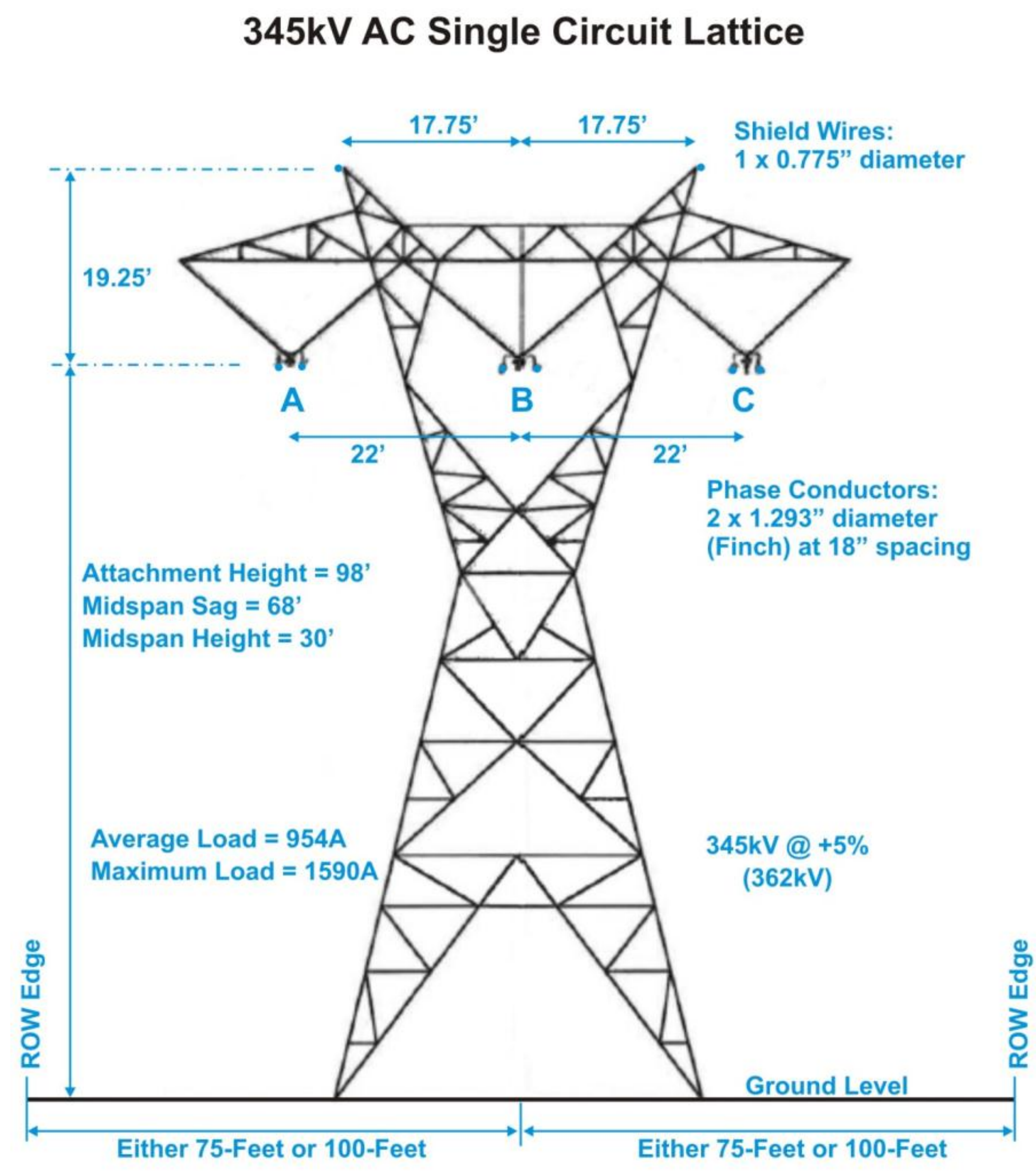
No electrical effects are associated with construction of the AC collection system routes, because thes AC transmission lines would not be energized during construction. Electrical facilities must be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.2.2.2 Operations and Maintenance Impacts

There are two different 345kV AC transmission line design configurations associated with the AC collection system in Oklahoma. Both line designs are single circuit configurations (i.e., one single circuit supported on a structure). The monopole line design is supported on a tubular pole, while the other design is a single circuit supported on a lattice structure. Each transmission line configuration is located within a representative 150-foot-wide to 200-foot-wide ROW (the actual ROW width has not yet been determined). Proposed loading for these lines is 570MW (945 amperes) for average loading and 950MW (1,590 amperes) for maximum loading. Figures 3.4-21 and 3.4-22 present dimensioned drawings of the two representative 345kV AC transmission line configurations.



1 Figure 3.4-21: 345kV AC Transmission Line Single Circuit Monopole Configuration



1 Figure 3.4-22: 345kV AC Transmission Line Single Circuit Lattice Tower Configuration

3.4.11.2.2.2.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the two transmission line configurations. Table 3.4-27 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Because the ROW width has not yet been determined, ROW edge values are provided for both possible edge locations (either 75 feet or 100 feet from the transmission centerline). Calculated field levels vary, depending upon the line configuration. Figure 3.4-23 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-27:
Calculated AC Electric Field Values for 345kV AC Transmission Lines Associated with the AC Collection System Alternatives

345kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	0.5	0.8	6.0	0.6	0.4
Single Circuit Lattice	0.6	1.3	6.0	1.3	0.6

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

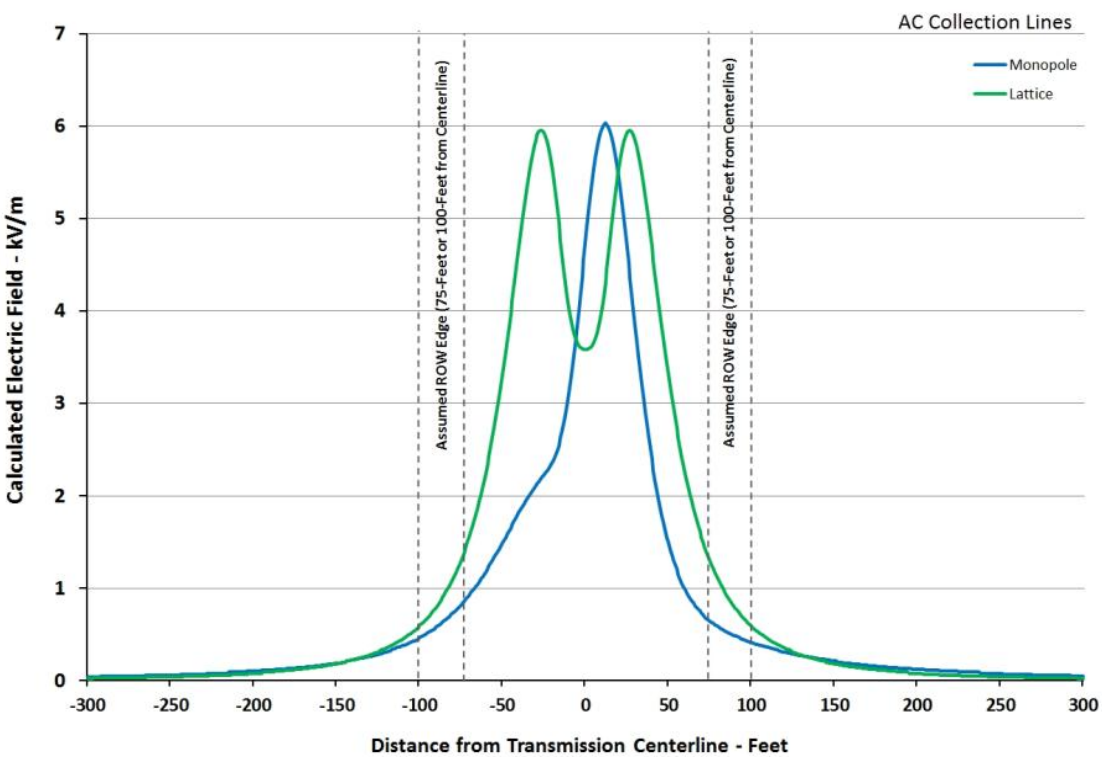


Figure 3.4-23: Calculated AC Electric Fields for 345kV AC Transmission Lines Associated with the AC Collection System

Calculated electric field levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for both AC transmission line configurations are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m, respectively). However, the maximum electric field within the ROW exceeds both of these public standards. Within the ROW, however, calculated electric field levels are below the ICES guideline of 10kV/m for a transmission line ROW. Calculated electric fields at the ROW edge exceed the ACGIH guideline of 1kV/m for workers with implanted medical devices for the single circuit lattice configuration if the ROW width is only 150 feet (as opposed to 200 feet).

3.4.11.2.2.2.2 AC Magnetic Field Calculation Results

AC magnetic field calculations were performed for both transmission line configurations under two different loading conditions (average and maximum loading of 945 amperes and 1,590 amperes respectively). Table 3.4-28 presents a summary of the calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration and the number of circuits present. Figure 3.4-24 presents a graph of the calculated AC magnetic field for each line configuration under average and maximum loading conditions.

Calculated magnetic field levels at the ROW edges for both AC transmission line interconnection designs are below the ICES and ICNIRP guidelines for public exposure (9,040 mG and 2,000 mG, respectively). Calculated magnetic field levels within the ROW are also below the ACGIH guideline of 1,000 mG for workers with implanted medical devices for both configurations.

Table 3.4-28:
Calculated AC Magnetic Field Values for 345kV AC Transmission Line Configurations Associated with the AC Collection System

345kV AC Transmission Line Configuration	Calculated AC Magnetic Field (mG) for Average/Maximum Load[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	18.3/30.5	28.4/47.3	138.3/230.4	33.0/55.1	20.3/33.9
Single Circuit Lattice	23.1/38.5	40.2/66.9	220.3/367.1	40.7/67.8	23.5/39.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

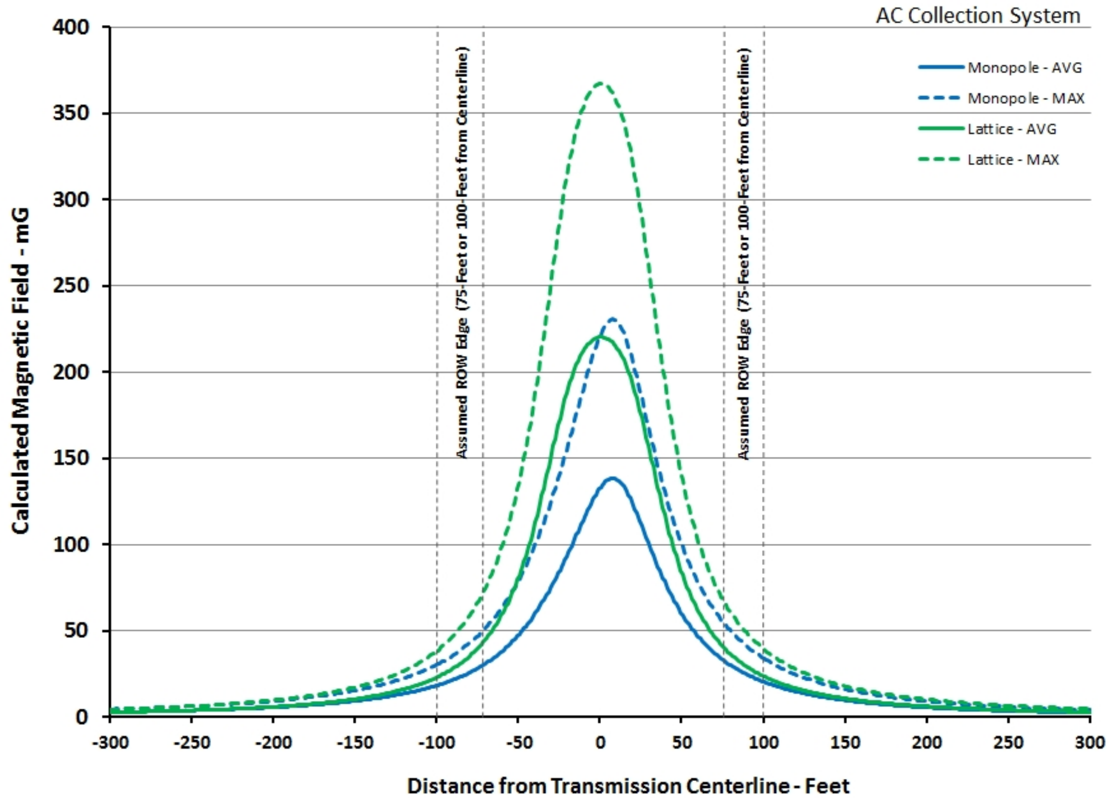


Figure 3.4-24: Calculated AC Magnetic Fields for 345kV AC Transmission Lines Associated with the AC Collection System

3.4.11.2.2.2.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for both AC transmission line configurations. Table 3.4-29 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-25 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-29:
Calculated Audible Noise for 345kV AC Transmission Line Configurations Associated with the AC Collection System

345kV AC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	47.9	48.9	51.6	49.1	48.1
Single Circuit Lattice	50.1	51.2	53.9	51.2	50.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

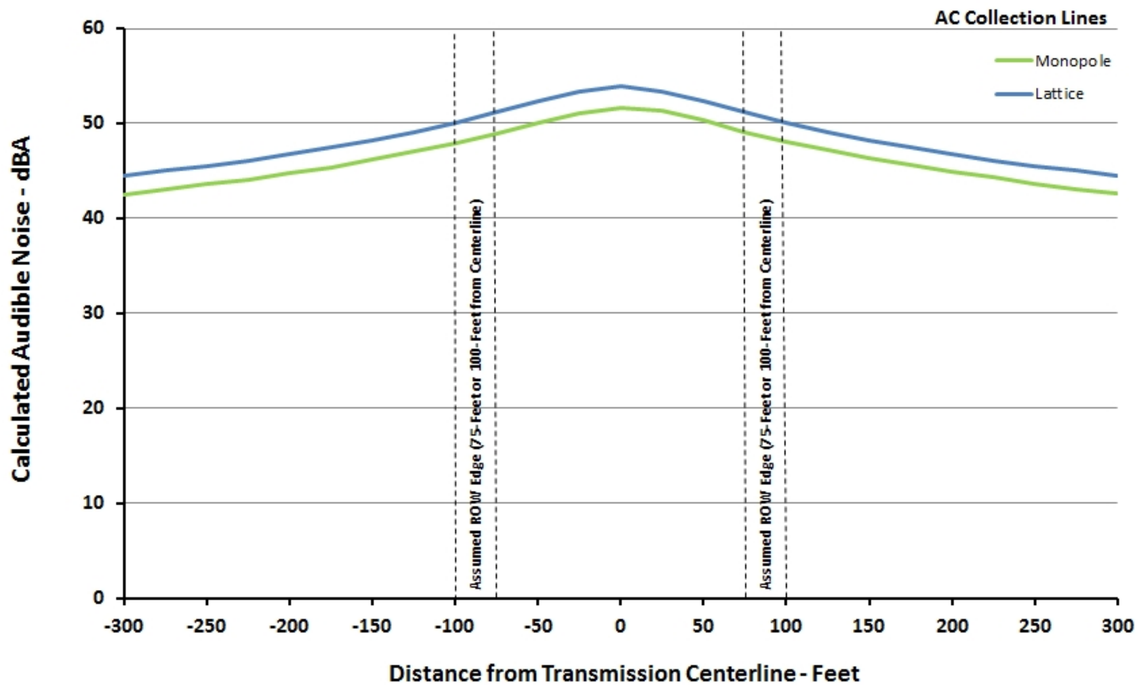


Figure 3.4-25: Calculated Audible Noise Levels (L_{dn}) for 345kV AC Transmission Lines Associated with the AC Collection System

Calculated audible noise levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the EPA guideline for L_{dn} (day-night) noise of 55 dBA. Calculated audible noise levels assume a 5 percent overvoltage condition at the highest line elevation (3,000 feet).

3.4.11.2.2.2.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for both AC transmission line designs for rainy and fair weather conditions. Table 3.4-30 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz for both weather conditions. Table 3.4-30 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-30, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold in fair weather conditions. Figure 3.4-26 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-27 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level).

Table 3.4-30:
Calculated Radio Noise for 345kV AC Transmission Line Configurations Associated with the AC Collection System Alternatives

345kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy/Fair Weather)[1]						
	-100 Feet from CL	-50 Feet from Outside Conductor	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+50 Feet from Outside Conductor	+100 Feet from CL
Single Circuit Monopole	57.7/40.7	64.9/47.9	61.9/44.9	78.7/61.7	61.1/44.1	64.3/47.3	57.6/40.6
Single Circuit Lattice	56.8/39.8	63.3/46.3	62.5/45.5	81.7/64.7	62.5/45.5	63.3/46.3	56.8/39.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes. Section 3.4.4 presents a discussion on radio noise interference and Section 3.4.6.6 on radio noise standards.

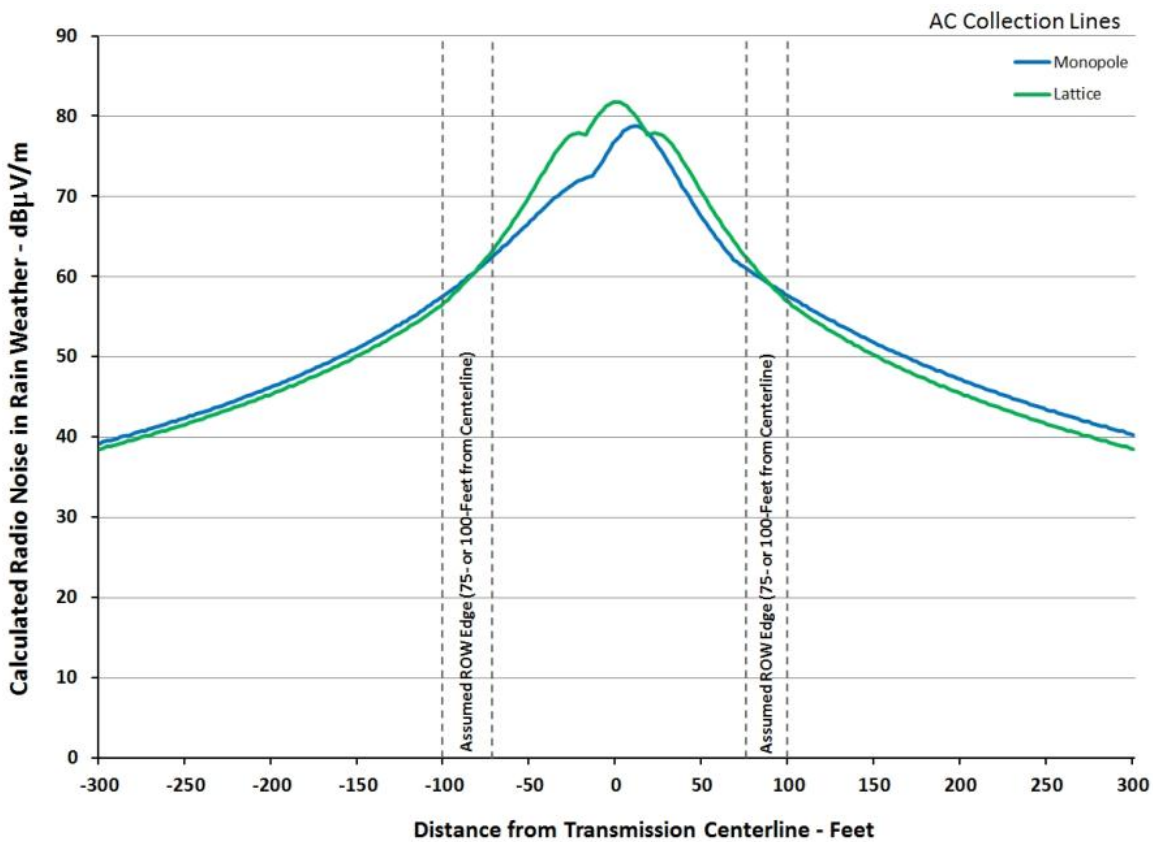


Figure 3.4-26: Calculated Radio Noise for 345kV AC Transmission Lines Associated with the AC Collection System (Rainy Weather)

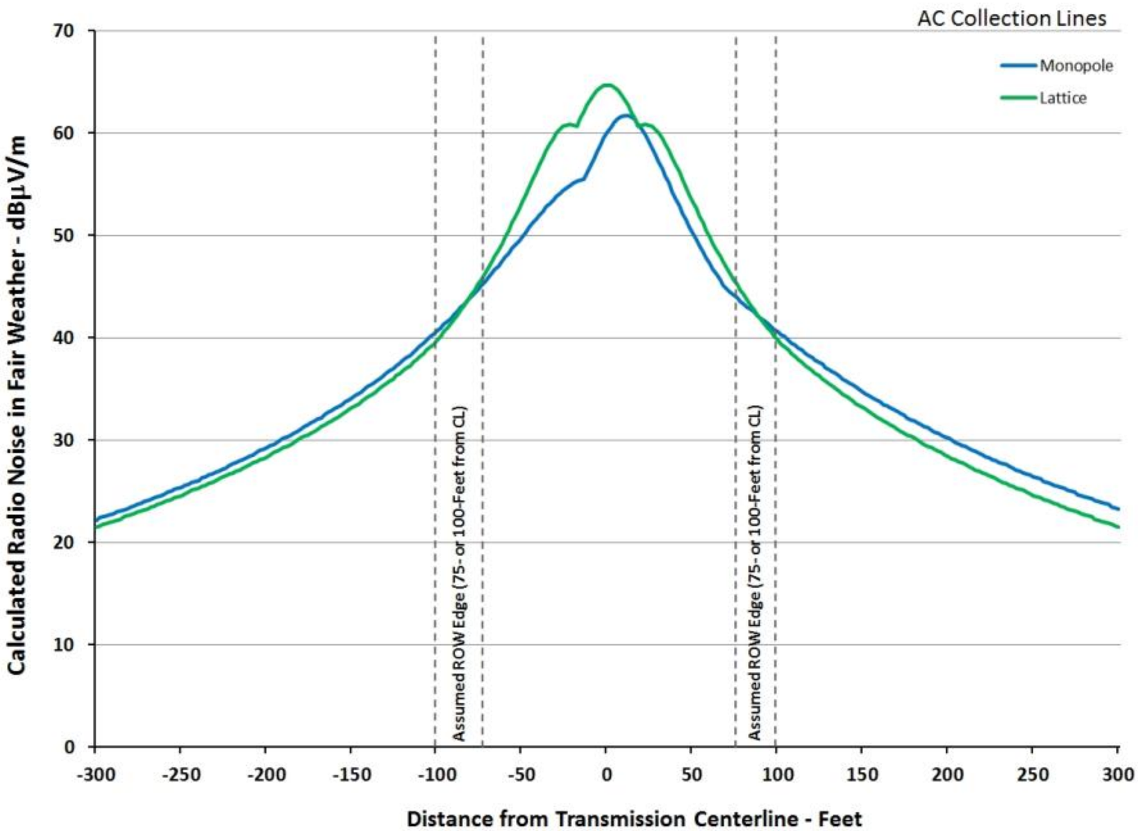


Figure 3.4-27: Calculated Radio Noise for 345kV AC Transmission Lines Associated with the AC Collection System (Fair Weather)

3.4.11.2.2.2.4.1 AC Television Noise Calculation Results

Television noise calculations were performed for both AC transmission line interconnections for rainy weather conditions. Table 3.4-31 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-28 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-31:
Calculated Television Noise for 345kV AC Transmission Line Configurations Associated with the AC Collection System

345kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	16.8	19.1	31.1	20.7	18.0
Single Circuit Lattice	20.0	22.4	34.1	22.4	20.0

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

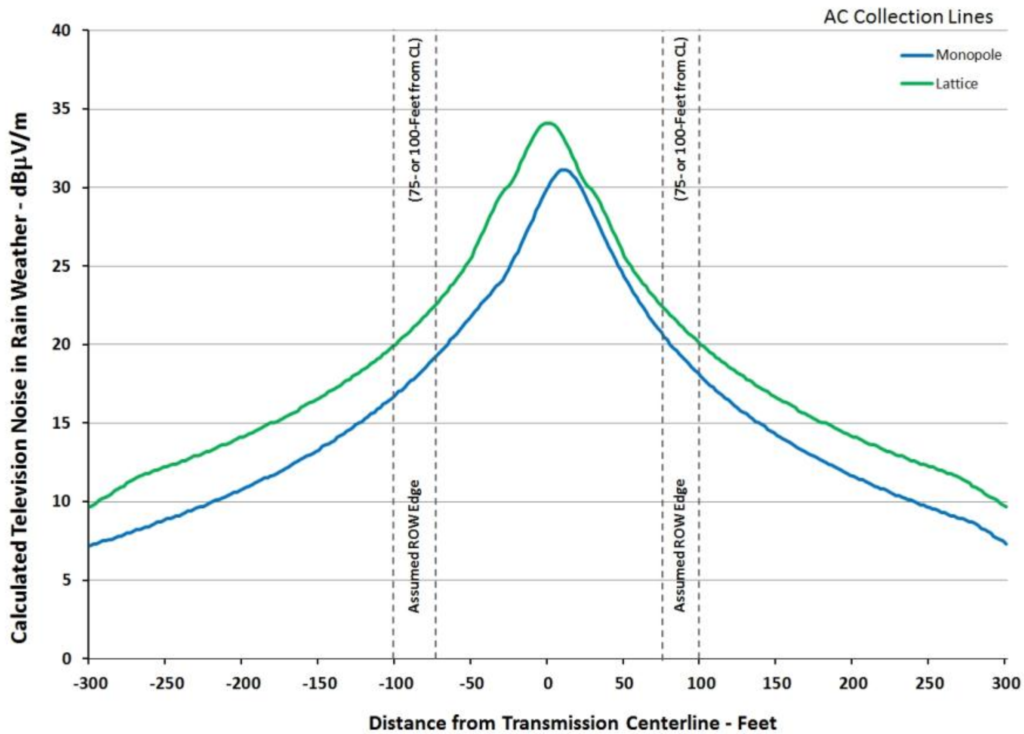


Figure 3.4-28: Calculated Television Noise for 345kV AC Transmission Lines Associated with the AC Collection System (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. However, the new digital broadcast system technology for radio and television should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a).

3.4.11.2.2.2.4.2 Ozone Calculation Results

Ozone levels for both AC transmission line designs were calculated for rainy weather conditions. Table 3.4-32 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations.

Table 3.4-32:
Calculated Ozone Levels for 345kV AC Transmission Line Configurations Associated with the AC Collection System

AC Transmission Configuration	Calculated Ozone (ppb)
	Maximum within +/-300 Feet of CL
Single Circuit Monopole	0.0
Single Circuit Lattice	0.1

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

3.4.11.2.2.2.5 Summary of Impacts for the AC Collection System

Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the AC collection system would pose a known threat to human health (reference Section 3.4.11.2.1.2.2.7). In addition, the likelihood of increased audible noise or interference to AM radio/television reception (due to operation of the line) rising to a level of annoyance is small.

While a variety of electronic devices are known to affect the operation of pacemakers and ICDs, transmission lines have not been reported to produce functional disturbances to these devices. There is a possibility that induced potentials on the leads of these devices by AC electric fields on the ROW could affect the operation of these devices, but the clinical significance of such changes appears small. Persons who are concerned should contact their physician to ascertain the immunity of their device to this potential source of interference.

3.4.11.2.2.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of any of the AC collection system. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.2.3 HVDC Applicant Proposed Route

Existing electrical facilities (such as overhead transmission lines) are present within each of the proposed transmission routes and regions, some of which already create electrical effects within the environment. Table 3.4-33 presents the number of existing AC transmission lines that parallel the Applicant Proposed Route, as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot corridor of each Applicant Proposed Route. Table 3.4-33 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot corridor for the Applicant Proposed Route.

Table 3.4-33:
Occurrence of Existing Facilities along the Applicant Proposed Route by Region

Applicant Proposed Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot Corridor (Residential/Agricultural/ Church/School)[1]	Existing Communication Facilities within 1,000-Foot Corridor (Quantity and Type)[2]
Region 1	4 (69-345kV)	8/24/0/0	0
Region 2	1 (115kV)	26/40/0/0	1 (TV)
Region 3	8 (69-345kV)	114/61/0/0	9 (MT, AS)
Region 4	9 (69-345kV)	151/74/1/0	3 (PM, AS)
Region 5	1 (500kV)	81/41/0/0	0
Region 6	1 (161kV)	26/26/0/0	0
Region 7	1 (161kV)	30/16/1/0	3 (PM, AS)

PM—Private Land Mobile, TV—Analog TV (National Television System Committee), MT—Microwave Tower, AS—Antenna Structure
1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a)
2 GIS Data Source: FCC (2012)

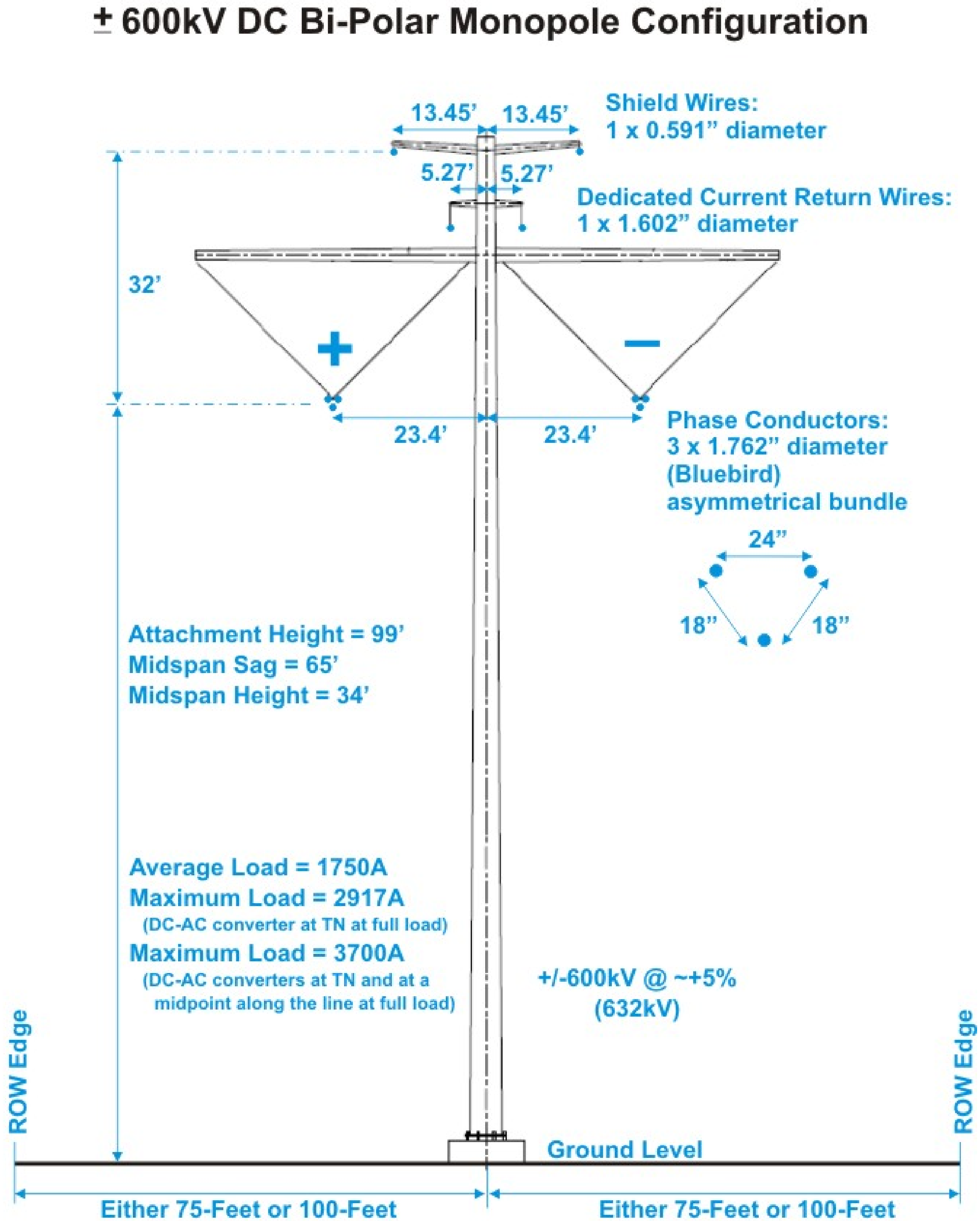
3.4.11.2.3.1 Construction Impacts

No electrical effects would be associated with construction of the Applicant Proposed Route, because the transmission line would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

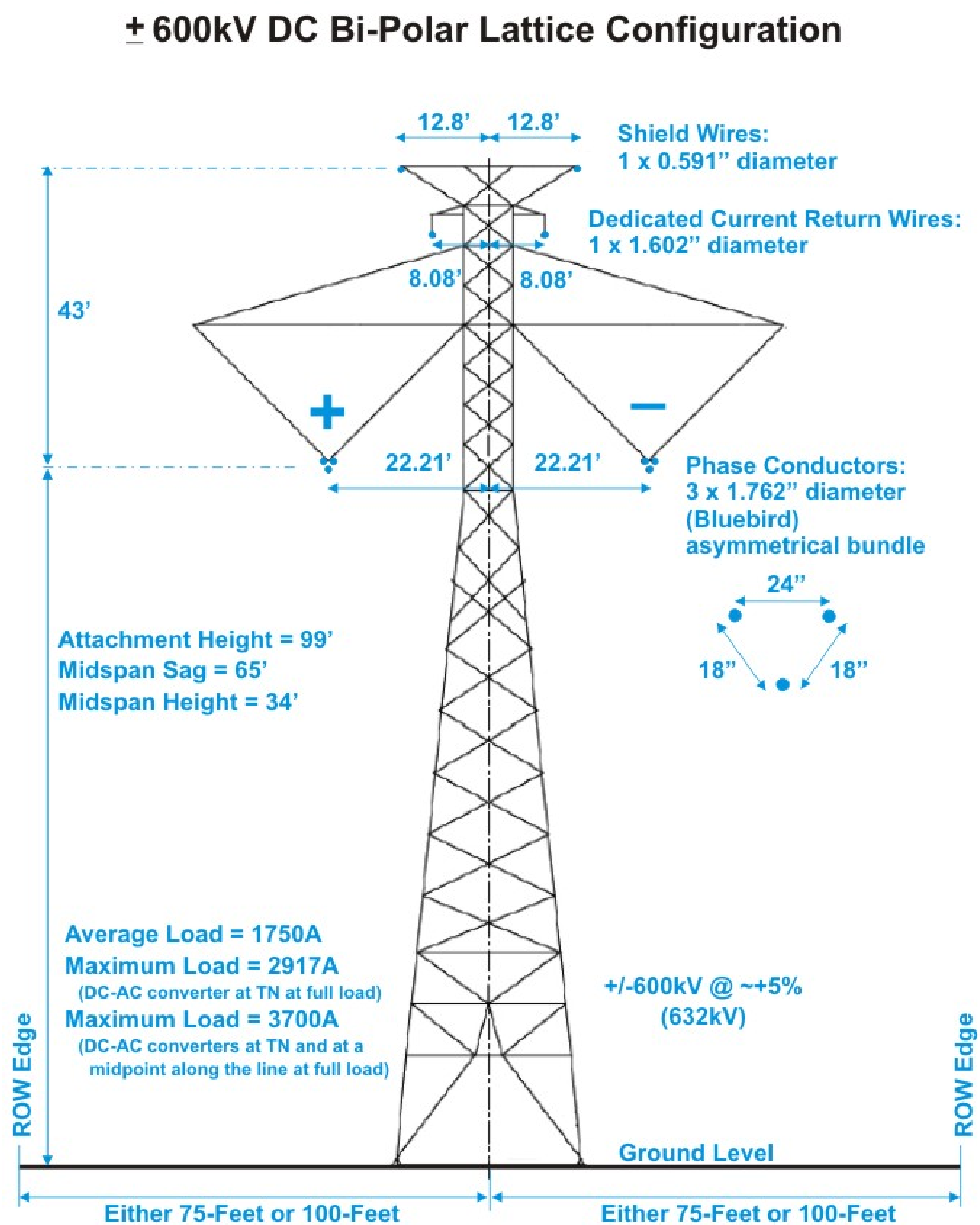
3.4.11.2.3.2 Operations and Maintenance Impacts

There are two ±600kV HVDC overhead electric transmission line configurations that may be utilized within the seven regions associated with the Applicant Proposed Route: monopole and lattice tower. Figure 3.4-29 presents a diagram of a representative monopole configuration, which is supported on a tubular pole. Figure 3.4-30 presents a diagram of a representative lattice tower configuration. It has not yet been determined which configurations may occur within these regions, so the results of the electrical effects associated with both of these configurations may be applicable to any and/or all of the proposed regions and are therefore assumed to be potentially common impacts to all regions.

Both line designs are bi-polar configurations, located within a 150-foot-wide to 200-foot-wide ROW (actual ROW width has not yet been determined). Under normal operating conditions, only the main conductor bundles will carry load. However, the HVDC transmission line is designed with two dedicated neutral return (DNR) conductors that could carry load during infrequent situations, such as when a main conductor bundle is de-energized for repair or maintenance. For each of the two transmission line designs (monopole and lattice tower), two different operating conditions were therefore modeled (standard/typical conductor load flow and DNR load flow on both return wires for one polarity).



1 Figure 3.4-29: Proposed ±600kV HVDC Transmission Line Monopole Configuration



1 Figure 3.4-30: Proposed ±600kV HVDC Transmission Line Lattice Tower Configuration

3.4.11.2.3.2.1 DC Electric Field Calculation Results

DC electric field calculations were performed for the two HVDC transmission line configurations. Table 3.4-34 presents a summary of the calculated DC electric field at the ROW edges and for the maximum field within the ROW. Because the ROW width has not yet been determined, ROW edge values are provided for both possible edge locations (either 75 feet or 100 feet from the transmission centerline). Calculated field levels vary, depending upon the line configuration. Figure 3.4-31 presents a graph of the calculated DC electric field for each line configuration using standard and DNR operating conditions with an approximate overvoltage condition of 10 percent at the highest line elevation (3,000 feet).

Table 3.4-34:
Calculated DC Electric Field Values for DC Transmission Line Configurations (Voltage Only)

DC Transmission Line Configuration	Calculated Electric Field (kV/m)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Monopole—Standard	2.7	5.7	+/- 19.4	-5.7	-2.7
Monopole—DNR	3.3	6.6	23.5	0.9	0.6
Lattice—Standard	2.6	5.4	+/- 19.6	-5.4	-2.6
Lattice—DNR	3.2	6.4	24.3	1.0	0.7

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

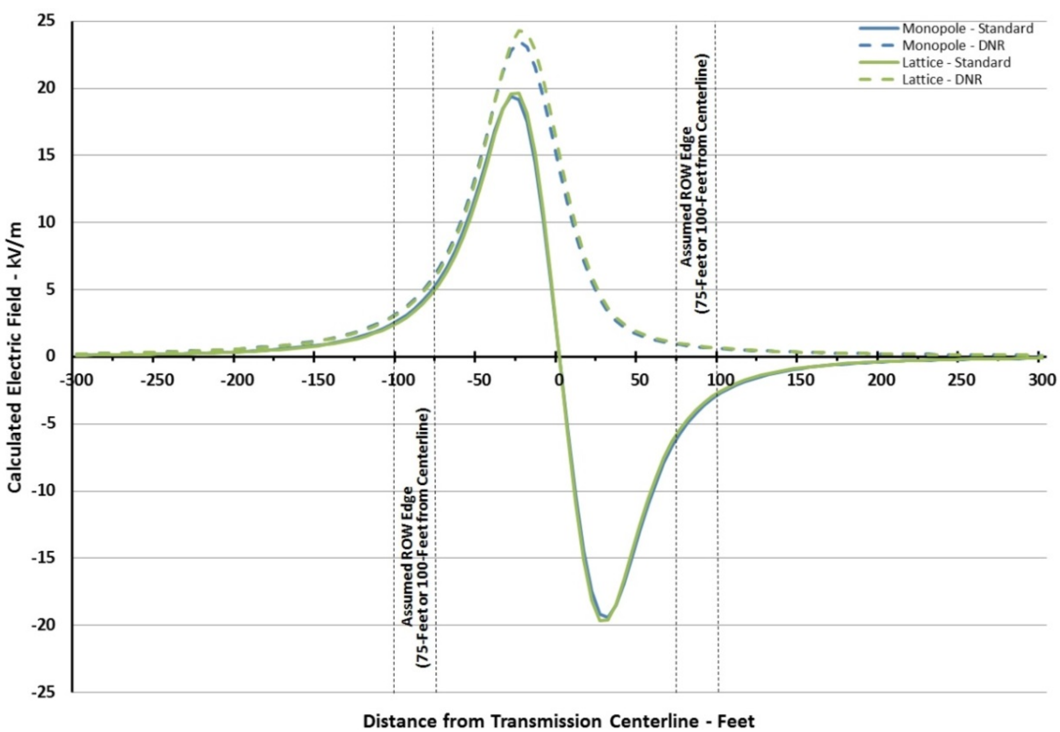


Figure 3.4-31: Calculated DC Electric Fields for ±600kV HVDC Transmission Line

Calculated DC electric field levels at the ROW edges (100 feet from the centerline of the transmission line) for both DC transmission line configurations are below the ICES and ICNIRP public guidelines (5kV/m). However, calculated DC electric field levels exceed the ICES and ICNIRP public guidelines (5kV/m) at some ROW edges at 75 feet from centerline and within the ROW. Calculated DC electric field levels conform to the ACGIH occupational standard (25kV/m) within the ROW for all configurations, but exceed the ICES and ICNIRP occupational standards (20kV/m) for the DNR configurations.

3.4.11.2.3.2.2 DC Magnetic Field Calculation Results

DC magnetic field calculations were performed for both transmission line configurations under three different loading conditions:

- Average loading of 1750 amperes
- Maximum loading of 2917 amperes when only the DC-AC converter at the Tennessee end of the line is supplied full load
- Maximum loading of 3700 amperes when both the DC-AC converter at the Tennessee end of the line and another DC-AC converter at a midpoint along the line are both being supplied full load

Table 3.4-35 presents a summary of the DC calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration. Figure 3.4-32 presents a graph of the calculated DC magnetic field for the monopole line configuration using standard and DNR operating conditions and for average and maximum loading conditions. Figure 3.4-33 presents a graph of the calculated DC magnetic field for the lattice tower configuration using standard and DNR operating conditions and for average and maximum loading conditions. In the standard configuration, load flow is balanced in both directions between the positive and negative phases, creating a magnetic field profile which peaks at centerline. In the DNR configuration, return load is split between the two dedicated neutral return conductors, creating a shift in the calculated field to the side more heavily loaded.

Table 3.4-35:
Calculated Magnetic Field Levels for DC Transmission Line Configurations

DC Transmission Line Configuration	Calculated Magnetic Field (mG) for Average/Maximum (1750A/2917A/3700A) Load[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Monopole—Standard	51.1/85.2/108.0	86.4/144.1/182.8	354.9/591.5/750.3	86.4/144.1/182.8	51.1/85.2/108.0
Monopole—DNR	46.1/76.8/97.4	76.4/127.4/161.6	219.2/365.4/463.5	44.9/74.9/95.0	30.1/50.2/63.7
Lattice—Standard	48.5/80.9/102.6	82.3/137.1/173.9	360.7/601.2/762.6	82.3/137.1/173.9	48.5/80.9/102.6
Lattice—DNR	51.9/86.6/109.8	84.7/141.2/179.1	237.5/395.9/502.2	51.1/85.2/108.1	34.8/57.9/73.5

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

Calculated DC magnetic field levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for both DC transmission line configurations are below guidelines for public exposure (1,180,000 mG for ICES and 4,000,000 mG for ICNIRP). Calculated DC magnetic field levels are also below the guidelines for implanted medical devices (5,000 mG for ACGIH, ICNIRP, and the FDA).

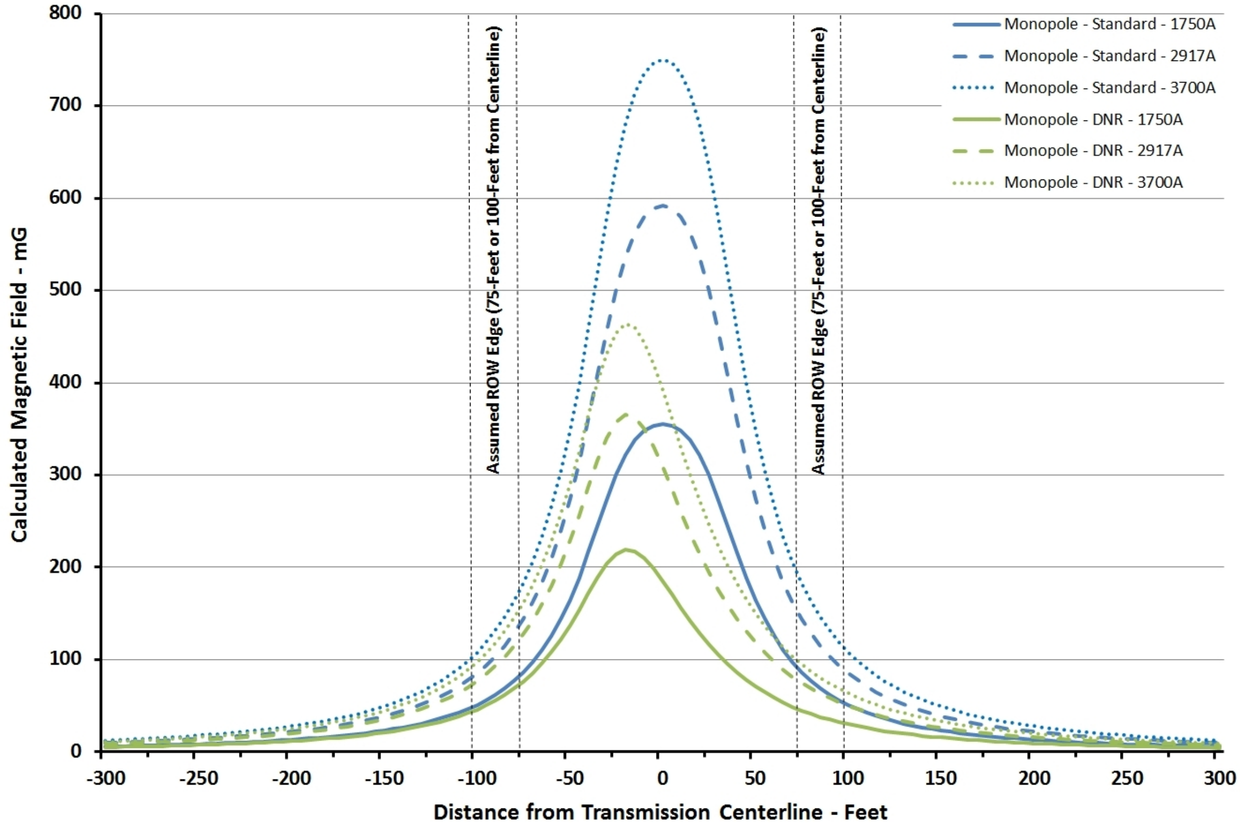


Figure 3.4-32: Calculated DC Magnetic Fields for ±600kV HVDC Transmission Line (Monopole Configuration)

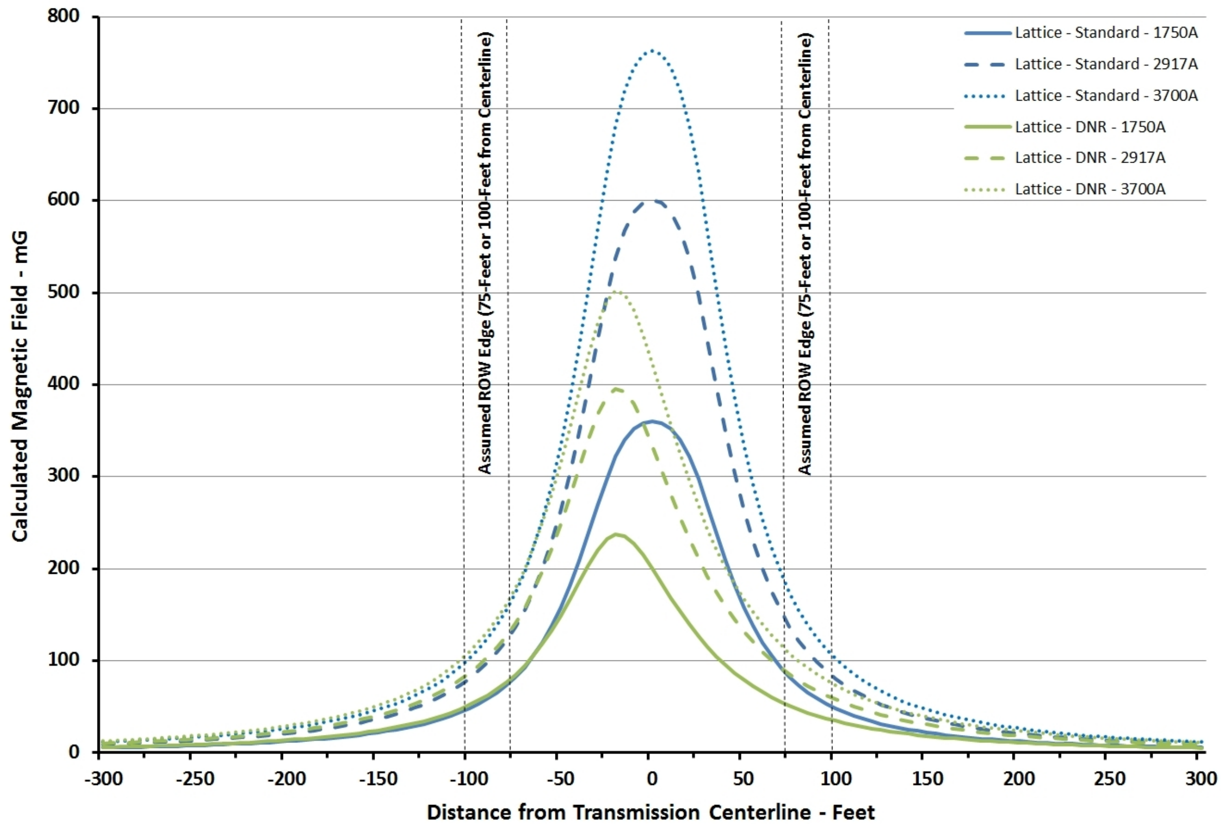


Figure 3.4-33: Calculated DC Magnetic Fields for ±600kV HVDC Transmission Line (Lattice Configuration)

3.4.11.2.3.2.3 DC Audible Noise Calculation Results

Audible noise calculations were performed for both DC transmission line configurations. Table 3.4-36 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-34 presents a graph of the calculated audible noise for each DC transmission line configuration.

Table 3.4-36:
Calculated Audible Noise for DC Transmission Line Configurations

DC Transmission Line Configuration	Calculated Audible Noise (dBA)—L_{dn}[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Monopole—Standard	54.7	55.8	57.5	53.8	52.8
Monopole – DNR	48.7	49.9	51.5	47.8	46.8
Lattice—Standard	55.2	56.4	58.1	54.4	53.4
Lattice—DNR	48.3	49.5	51.2	47.5	46.5

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

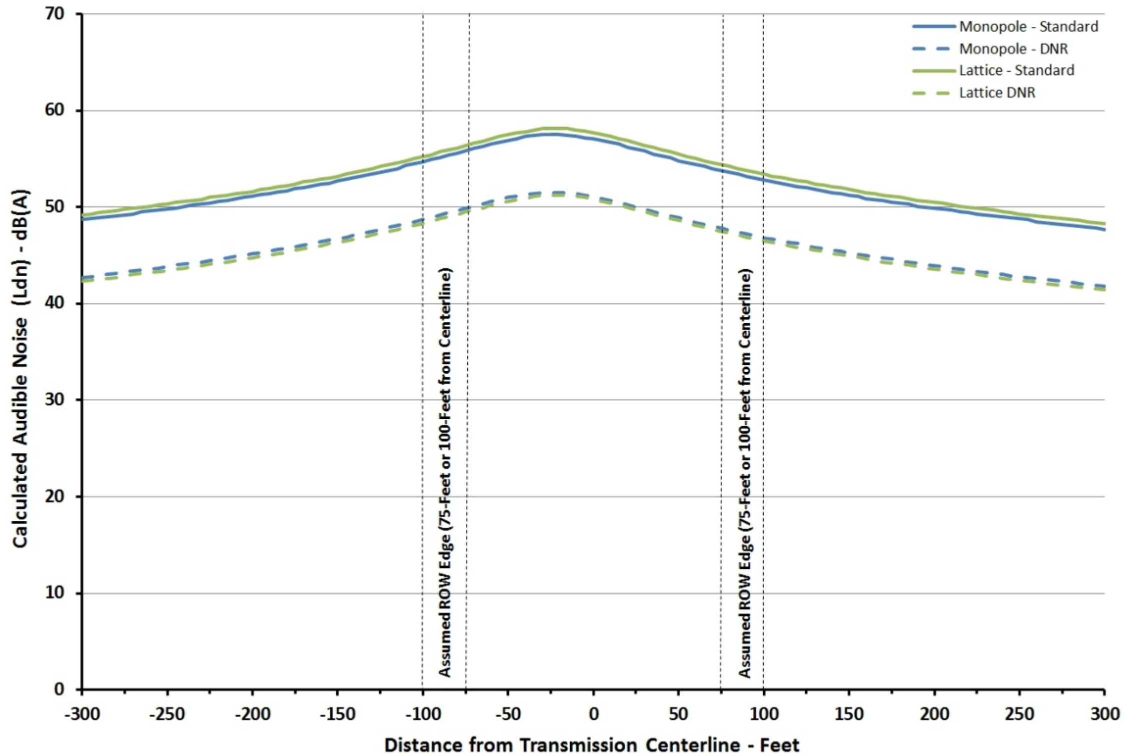


Figure 3.4-34: Calculated Audible Noise Levels (L_{dn}) for ±600kV HVDC Transmission Line

Calculated audible noise levels at the ROW edges (100 feet from centerline of the transmission line) for the standard monopole and lattice line configurations are at or below the EPA guideline for L_{dn} (day-night) noise of 55 dBA (the lattice configuration is slightly higher than the EPA guideline at 55.2 dBA, but calculated audible noise levels assume a 5 percent overvoltage condition at the highest line elevation (3,000 feet). At the ROW edges (75 feet from centerline of the transmission line), calculated audible noise levels typically exceed the EPA standard. For all configurations utilizing the DNR configuration, calculated audible noise levels are below the EPA standard at either ROW edge (either 75 feet or 100 feet from the transmission line).

3.4.11.2.3.2.4 DC Radio Noise Calculation Results

Radio noise calculations were performed for both DC transmission line designs for rainy weather conditions. Table 3.4-37 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz. Calculated radio noise levels vary, depending upon the line configuration. As shown in Table 3.4-37, calculated radio noise levels at 50 feet from the outside conductor are below the IEEE 61 dB:V/m threshold in fair or rainy weather for all configurations. Figure 3.4-35 presents a graph of the calculated radio noise levels for each DC line configuration in rainy weather at the 500kHz reference level.

Table 3.4-37:
Calculated Radio Noise Values for DC Transmission Line Configurations in Rainy Weather

DC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy Weather)[1]						
	-100 Feet from CL	-75 Feet from CL	-50 Feet from Outside Conductor	Maximum on ROW	+50 Feet from Outside Conductor	+75 Feet from CL	+100 Feet from CL
Monopole—Standard	52.3	57.0	57.7	68.6	56.4	56.0	52.9
Monopole—DNR	47.9	52.8	53.5	65.3	54.6	54.3	51.3
Lattice—Standard	52.0	56.6	57.3	69.0	56.7	56.3	52.9
Lattice—DNR	48.6	52.2	52.8	65.0	54.5	54.2	51.6

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

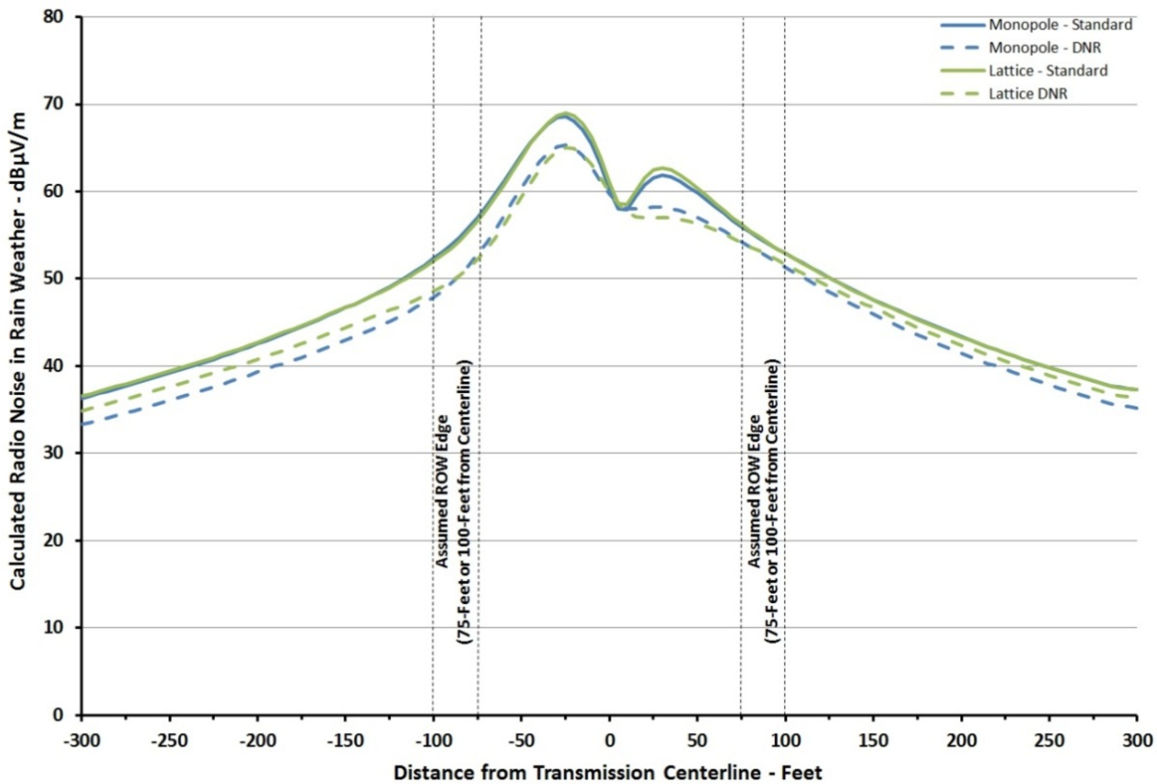


Figure 3.4-35: Calculated Radio Noise for ±600kV HVDC Transmission Line (Rainy Weather)

3.4.11.2.3.2.5 Air Ion Calculation Results

Air ion concentration levels for both DC transmission line configurations and operating conditions were calculated. Table 3.4-38 presents a summary of the calculated air ion concentration levels at the ROW edges and for the maximum field within the ROW.

Table 3.4-38:
Calculated Ion Density Levels for DC Transmission Line Configurations

DC Transmission Line Configuration	Calculated Ion Density Level (ions/cm^3)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Monopole—Standard	31,300	65,100	+/- 284,400	-65,100	-31,300
Monopole—DNR	41,500	87,000	390,700	19,200	11,200
Lattice—Standard	29,800	62,300	+/-295,700	-62,300	-29,800
Lattice—DNR	40,100	83,900	408,600	20,600	12,500

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline

Air ion exposures have been extensively studied with no clear evidence of effects. Studies of exposures ranging from ambient levels to levels much higher than those found in proximity of HVDC lines have been made, but findings have often been inconsistent and many studies have reported no effect (Hauth et al. 1997).

3.4.11.2.3.2.6 Overview of DC Electrical Effects Research on Human Health

Research has been conducted in the United States and around the world to determine whether exposure to static DC electric and magnetic fields has human health effects. For DC electric and magnetic fields, studies have shown no consistent evidence of adverse human health effects for exposure to levels comparable to those encountered underneath DC transmission lines. Some DC electric field effects, such as hair sensation (the perception experienced by electrical stimulation of the hair on the arm or head) and spark discharges or micro-shocks (a person touches a grounded object and discharges built-up voltage) may be annoying or uncomfortable to experience (EPRI 2012).

The following discussions report on various organizations and study results concerning DC electrical effects and their conclusions:

- An EPRI State of the Science Report on HVDC transmission lines stated that numerous studies of the effects of DC fields and space charges (air ions) have been made with the general conclusion that there are no significant effects on either humans or animals. In addition, public health surveys and field studies conducted at new HVDC overhead transmission lines indicate that the environment surrounding these lines is not harmful to humans, animals, or crops (EPRI 2010).
- An Oak Ridge National Laboratory review paper summarized that there is no mechanism to explain how exposure to external static fields could produce adverse biological responses. Although the database of studies is small, the experiments overall do not indicate a clear pattern of effect, and provide no basis to conclude that exposure to electric fields, such as those associated with the electric field of a HVDC transmission line, pose health risks (Hauth et al. 1997).
- The WHO published the Environmental Health Criteria 232 (EHC 232) to address the possible health effects of exposure to static electric and magnetic fields. For DC electric fields, this report found that none of the studies conducted to date suggests any untoward health effects, except for possible stress resulting from prolonged exposure to micro-shocks. The WHO did not recommend further research concerning biological effects from exposure to static electric fields. For DC magnetic fields, the WHO officially recognizes the ICNIRP exposure

guidelines advice (based upon the health risk assessments published by the WHO and cancer reviews and classifications carried out by the IARC (WHO 2006).

The HVDC transmission line will produce DC electric and magnetic fields that are similar to those encountered in the natural environment, with magnetic field levels similar to the earth's static geomagnetic field on the ROW (depending upon the line loading) and electric field levels outside ROW similar to those produced by atmospheric phenomena. Based upon the reviews of scientific research, it is unlikely that the DC fields from the Project would have adverse effects on human health. This section is not a comprehensive review of the entire body of evidence, and excludes consideration of many other relevant published scientific studies. Scientific research utilizes epidemiology studies, animal models, and laboratory studies of basic mechanisms to scientifically evaluate a disease risk.

3.4.11.2.3.2.7 Overview of DC Electrical Effects Research on Pacemakers and Implanted Medical Devices

Public concern has been expressed related to the electric and magnetic fields of HVDC transmission lines with the possibility of interference with cardiac pacemakers. Persons with implanted medical devices are constantly exposed to DC electric and magnetic fields from the earth's natural environment. The human body shields implanted medical devices from DC electric fields, protecting the device from naturally occurring electric field interference (EPRI 2012). Medical devices are also designed to withstand electrostatic discharge from DC electric fields. There is also constant exposure from the earth's static magnetic field, which is about 0.51 G in the states encompassing Regions 1 through 7. Guidelines for occupational exposure suggest that DC electric field exposure should not exceed 5 G for DC magnetic fields for workers with cardiac pacemakers (ACGIH 2010; ICNIRP 2009). The FDA also recommends a limit of 5G for MRI patients with pacemakers (FDA 1998). The potential for pacemaker interference from transmission line fields depends on the manufacturer, model, and implantation method, among other factors.

Other implanted medical devices can include a magnetic valve used in a cranial shunt. Typically, implanted medical devices such as this are set by the doctor within their office or medical facility using a static (DC) magnetic field tool to remotely adjust the valve settings on those implanted devices with adjustable magnetic valves. The presence of strong static (DC) magnetic fields, such as those associated with permanent magnets (such as refrigerator magnets or magnets used in toys), can potentially interact with the programmed settings of a cranial shunt. Patients exposed to stronger static magnetic fields from MRI machines can have even greater chances of interference with cranial shunts. According to some manufacturer's specifications (e.g., Medtronic 2012; Aesculap 2012; Codman 2006; and Sophyusa 2009, 2014), patients with cranial shunts should be able to undergo an MRI up to 3 Tesla (30,000,000 mG or 30,000 Gauss) of static magnetic field without experiencing interference with their device. Studies have also been performed about static magnetic fields effects on programmable shunts that are produced by permanent magnets (Liu et al. 2005) and MRI machines (Shellock et al. 2007), as well as numerous other studies (e.g., Miwa et al. 2001; Utsuki et al. 2006; Zuzak et al. 2009; Anderson et al. 2004; Inoue et al. 2005).

Manufacturer's testing of magnetic valves focuses on static magnetic fields rather than on low level AC magnetic fields such as those produced by AC transmission lines. Because adjustable cranial shunts utilize a static magnetic field tool to remotely adjust the settings on the device, AC magnetic fields are not routinely considered for interference evaluation or testing (and testing is not required by the FDA). If low AC magnetic field levels did influence these types of devices, then common appliances (such as hair dryers, shavers, and other household devices) would also be of concern. Medical manufacturers have reported that AC magnetic fields have not caused interference with magnetic shunts (Medtronic 2012). As with any implanted medical device, the user should always consult with their doctor and the device manufacturer to determine safe operational parameters for use of their medical device.

Patients with implanted medical devices should observe certain precautions and need to discuss their treatment with their doctor or physician. In addition, there are a variety of different medical devices that are constantly evolving and changing. It is also impossible to quantify all of the various types of magnetic field sources encountered in people's day-to-day lives. The potential for interference to implanted devices may depend upon a variety of different parameters, including the device manufacturer, model and setting, and implantation method, among other factors. Typically implanted medical devices are set specifically for an individual by their doctor or physician within the doctor's office or medical facility. As with any implanted medical device, the user should always consult with their doctor and the device manufacturer to determine safe operational parameters for use of their specific medical device and associated medical condition.

In summary, implanted medical devices are shielded by the body from DC electric fields, but even so, the DC magnetic field, even under the line, is too weak to potentially affect the operation of pacemakers and other implanted medical devices.

3.4.11.2.3.2.8 Overview of DC Electrical Effects Research on Plant and Animal Health

Research has been conducted to determine whether exposure to static DC has environmental effects on plant or animal life. Studies have examined the effect of static electric and magnetic field exposure on plant species and found no adverse effects due to DC electric and magnetic field exposure. Studies on some groups of animals also did not find any effect due to DC electric or magnetic fields. The following discussions report on various study results concerning DC electrical effects and their conclusions:

- A 1988 agricultural study performed by Oregon State University monitored beef cattle and crops near the 500kV DC Pacific Intertie transmission line in central Oregon. Researchers established simulated farming and ranching conditions directly under the transmission line and at an identical site 2,000 feet away. For the study, cattle were bred for three seasons, wheat and alfalfa was raised for 2 years, and data from the two sites were then compared. The cattle showed no differences in any health-related measures, including food and water consumption, growth, reproduction, disease, and death rate. Similarly, the wheat and alfalfa grown at the two sites showed no significant differences in growth, yield, or quality (Raleigh 1988).
- The University of Minnesota used records from the Dairy Herd Improvement Association to study the health and productivity of approximately 500 dairy herds—about 24,000 cows—located near a 400kV DC transmission Line in Minnesota. Researchers examined records from three years before to three years after energization of the transmission line. Herd health and productivity were unchanged over this time, regardless of proximity to the line (Martin et al. 1983).
- Domestic animals grazing near transmission lines are subject to potentially higher levels of DC electric and magnetic field exposure than large game species. Successive offspring of cattle exposed to a 500kV DC transmission line also showed no adverse effects (Angell et al. 1990). No effect was observed in the reproduction of cows and sheep exposed under relatively controlled conditions (Lee et al. 1996).
- A study on cattle and deer herds reported that the animals preferentially aligned themselves along the geomagnetic axis (Begall et al. 2008). Satellite images were used to obtain alignment data for herds over various regions of the earth. A second study (Burda et al. 2009) reported this alignment was disrupted for herds near AC transmission lines. However, a third research group (Hert et al. 2011) was unable to confirm the results using the

same satellite-based images. Two different statistical evaluation methods (one evaluation method tried to replicate the original study and the second tried an improved method) did not replicate the same findings.

This section provides a review of many of the relevant scientific studies that have been published and is not meant to be a comprehensive review of the entire body of evidence (many other scientific studies have been performed). Based upon a comprehensive review of the scientific literature, the association between DC magnetic fields and adverse effects to plant life and animal health is weak. Overall, studies of DC transmission line environments and DC electric and magnetic fields indicate that the field levels associated with the project would be unlikely to pose a threat to animals and plants.

3.4.11.2.3.2.9 Summary of Impacts for the HVDC Transmission Line

Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the proposed HVDC transmission line would pose a known threat to human health (see Section 3.4.11.2.3.2.6) along the Applicant Proposed Route. Calculated DC electric fields are above non-regulatory standards for some configurations and operating conditions within the ROW (depending upon ROW width). There is a possibility that induced potentials on the leads of these devices by DC electric fields on the ROW could affect the operation of these devices, but the clinical significance of such changes appears small. Persons who are concerned should contact their physician to ascertain the immunity of their device to this potential source of interference.

3.4.11.2.3.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of the ±600kV HVDC transmission line. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.3 Impacts Associated with the DOE Alternatives

This section describes the electrical effects associated with the DOE Alternatives, which includes the Arkansas converter station, the AC transmission line interconnection associated with it, and the HVDC alternative routes. Electrical effects would only be present during operation and maintenance of these facilities. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the project.

Table 3.4-39 presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within a 1,000-foot-wide corridor for the interconnection route. Currently, no AC transmission lines or communication facilities exist within the siting area.

Table 3.4-39:
Occurrence of Existing Facilities along DOE Alternative Converter Station and AC Interconnection Siting Area

DC Transmission Interconnection Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot Corridor (Residential/Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot Corridor (Quantity and Type)[2]
Arkansas	0	38/28/1/0	0

1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a)
2 GIS Data Source: FCC (2012)

3.4.11.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.4.11.3.1.1 Construction Impacts

No electrical effects would be associated with construction of the Arkansas converter station, because the converter station would not be energized during construction. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, or radio and television interference.

3.4.11.3.1.2 Operations and Maintenance Impacts

For the Arkansas converter station, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the station. Some types of substation and switching station equipment can potentially be a source of electrical effects (e.g., power transformers can produce audible noise; converter equipment can produce radio noise, etc.). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Because the dominant sources of electrical effects are associated with the overhead transmission lines, an evaluation of electrical effects for the proposed Arkansas converter station was therefore not performed, except for audible noise as described in Section 3.11.6.

There are two different 500kV AC transmission line configurations associated with the interconnection into the Arkansas converter station. Both line designs are single circuit configurations (i.e., one circuit supported on a single structure). The monopole design is supported on a tubular pole, while the other design is a single circuit supported on a lattice structure. Each transmission line configuration is located within a 150-foot-wide to 200-foot-wide ROW (actual ROW width has not yet been determined). Proposed loading for these lines is 300MW (346 amperes) for average loading and 500MW (577 amperes) for maximum loading. Figures 3.4-36 and 3.4-37 present dimensioned drawings of the two representative 500kV AC transmission line configurations.

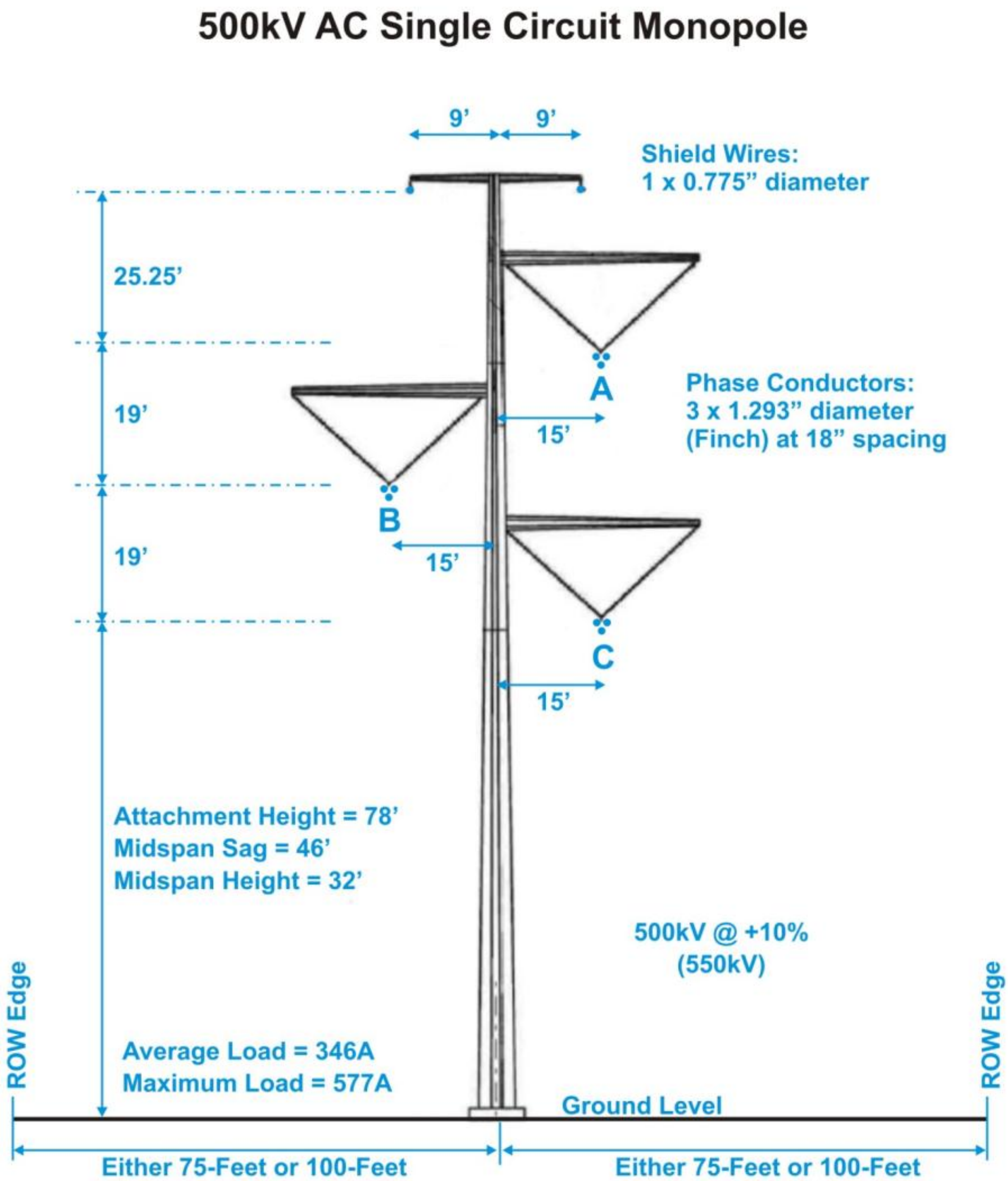


Figure 3.4-36: 500kV AC Transmission Line Double Circuit Monopole Configuration for Interconnection to Arkansas Converter Station

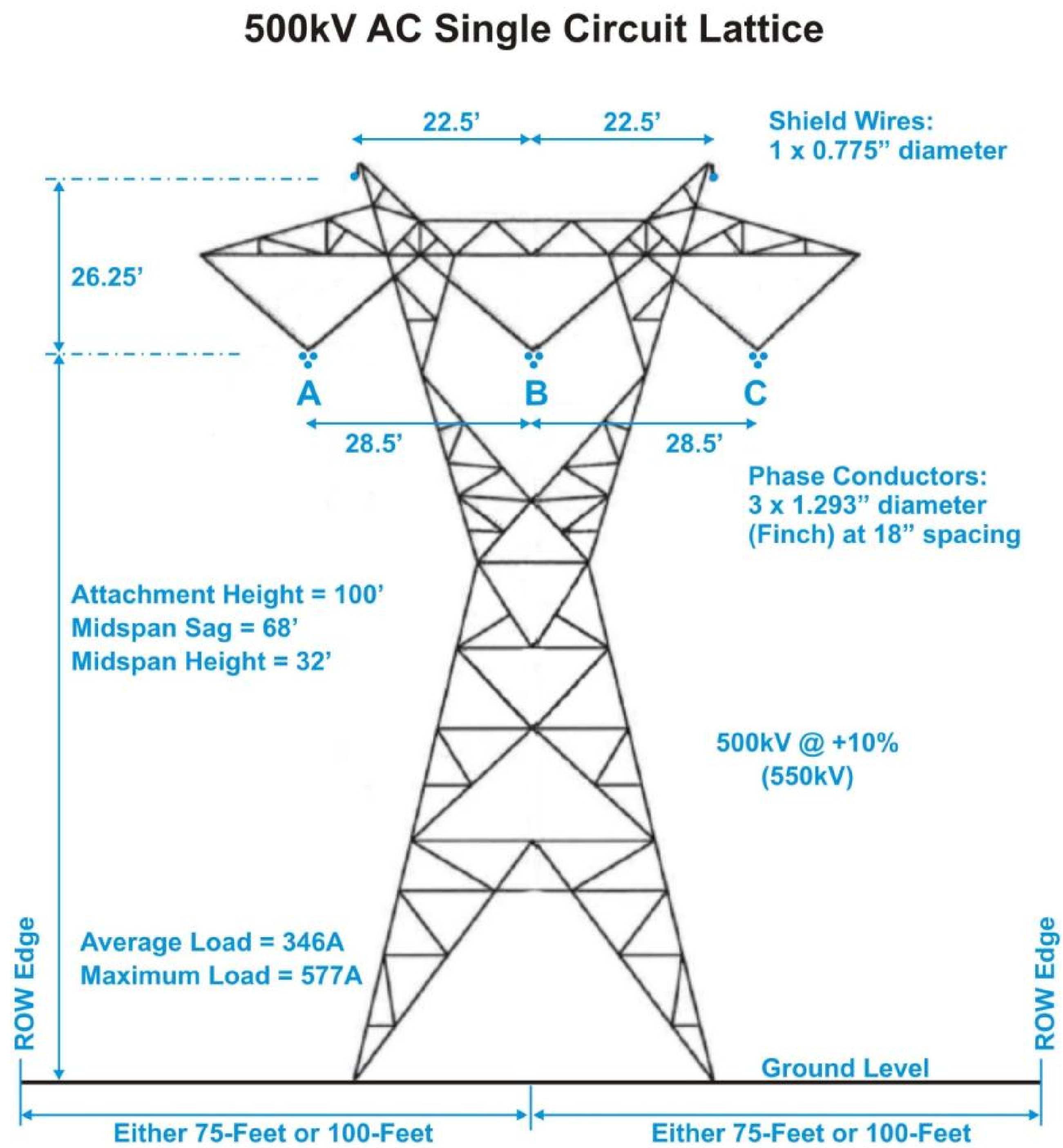


Figure 3.4-37: 500kV AC Transmission Line Double Circuit Lattice Tower Configuration for Interconnection to Arkansas Converter Station

3.4.11.3.1.2.1 AC Electric Field Calculation Results

AC electric field calculations were performed for the two transmission line configurations. Table 3.4-40 presents a summary of the calculated electric field at the ROW edges and for the maximum field within the ROW. Because the ROW width has not yet been determined, ROW edge values are provided for both possible edge locations (either 75 feet or 100 feet from the transmission centerline). Calculated field levels vary, depending upon the line configuration. Figure 3.4-38 presents a graph of the calculated AC electric field for each line configuration.

Table 3.4-40:
Calculated AC Electric Field Values for AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated AC Electric Field (kV/m)[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	1.1	1.9	10.0	1.5	0.9
Single Circuit Lattice	1.4	3.1	10.2	3.1	1.4

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

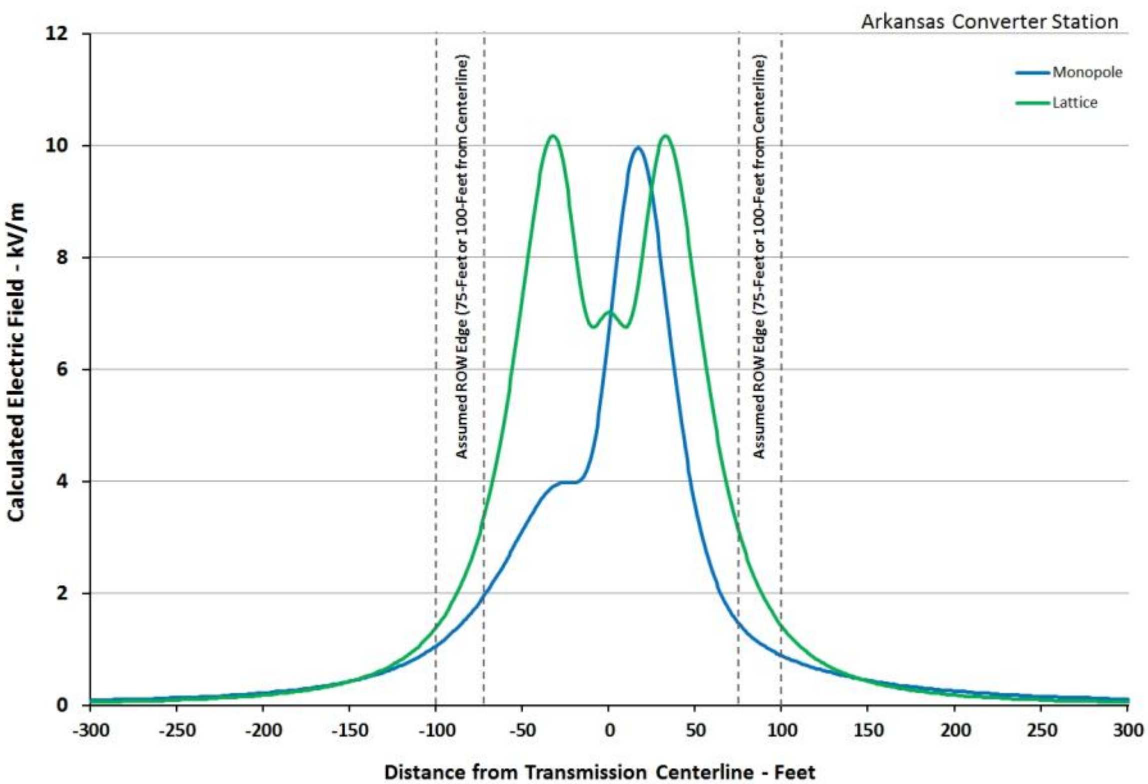


Figure 3.4-38: Calculated AC Electric Fields for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

Calculated electric field levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for all of the AC transmission line interconnections are below the ICES and ICNIRP guidelines for public exposure (5kV/m and 4.2kV/m respectively). Within the ROW, calculated electric field levels are slightly higher than the ICES guideline of 10kV/m for the single circuit lattice tower configuration. For both configurations, calculated electric field levels exceed the ACGIH guideline of 1kV/m for workers with implanted medical devices within the ROW and at most ROW edges.

3.4.11.3.1.2.2 AC Magnetic Field Calculation Results

AC magnetic field calculations were performed for the two transmission line configurations under two different loading conditions (average and maximum loading of 300MW [346 amperes] and 500MW [577 amperes] respectively). Table 3.4-41 presents a summary of the calculated magnetic field at the ROW edges and for the maximum field within the ROW. Calculated field levels vary, depending upon the line configuration and loading conditions. Figure 3.4-39 presents a graph of the calculated AC magnetic field for each line configuration under average and maximum loading conditions.

Table 3.4-41:
Calculated AC Magnetic Field Values for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated AC Magnetic Field (mG) for Average/Maximum Load[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	7.9/13.2	12.1/20.1	50.5/84.2	14.5/24.2	9.0/15.0
Single Circuit Lattice	11.1/18.5	19.4/32.4	78.9/131.6	19.6/32.7	11.3/18.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

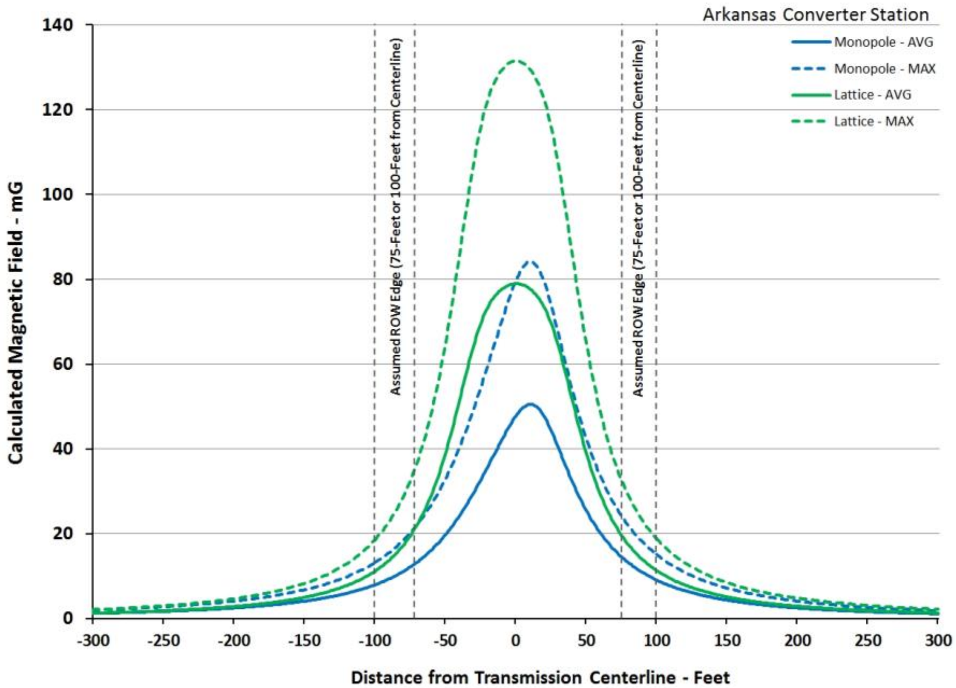


Figure 3.4-39: Calculated AC Magnetic Fields for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Average and Maximum Loading)

Calculated magnetic field levels at the ROW edges for both AC transmission line interconnection designs are below the ICES and ICNIRP guidelines for public exposure (9,040 mG and 2,000 mG, respectively). Calculated magnetic field levels within the ROW are also below the ACGIH guideline of 1,000 mG for workers with implanted medical devices for both configurations.

3.4.11.3.1.2.3 AC Audible Noise Calculation Results

Audible noise calculations were performed for both AC transmission line interconnection designs. Table 3.4-42 presents a summary of the calculated day-night (L_{dn}) audible noise at the ROW edges and for the maximum noise level within the ROW. Calculated levels vary, depending upon the line configuration. Figure 3.4-40 presents a graph of the calculated audible noise for each AC transmission line configuration.

Table 3.4-42:
Calculated Audible Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

	Calculated Audible Noise (dBA)—L_{dn}[1]				
500kV AC Transmission Line Configuration	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	54.8	55.8	58.4	56.3	55.3
Single Circuit Lattice	56.7	57.8	60.2	57.8	56.7

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.
1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

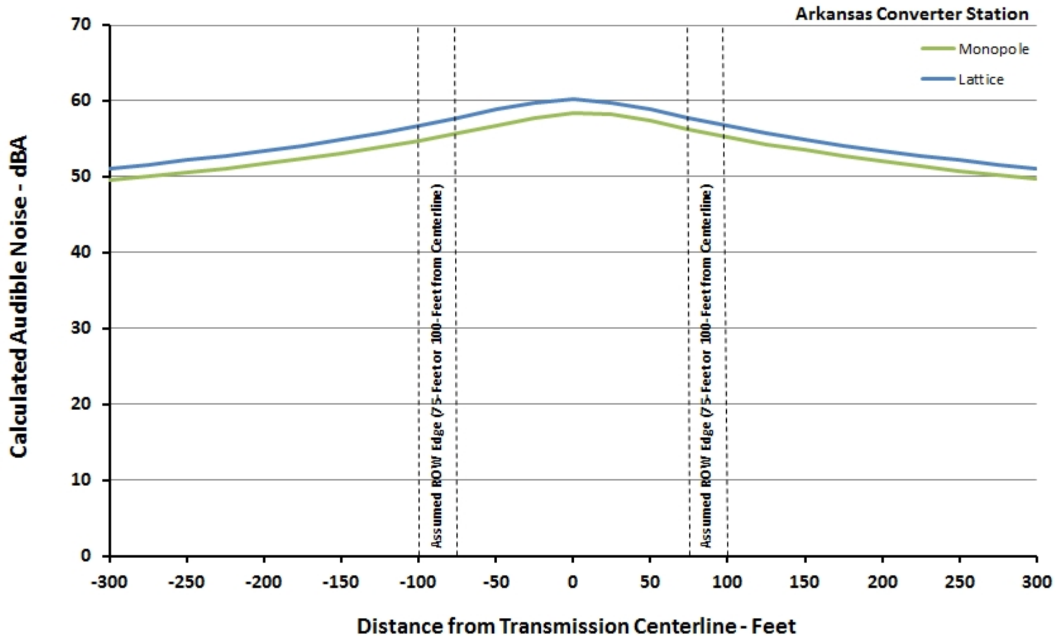


Figure 3.4-40: Calculated Audible Noise Levels (L_{dn}) for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

Calculated audible noise levels at the ROW edges (either 75 feet or 100 feet from centerline of the transmission line) for both AC transmission line interconnections are at or above the EPA guideline for L_{dn} (day-night) noise of 55 dBA (the monopole configuration is just under the EPA guideline at 54.8 dBA for one ROW edge at 100 feet from centerline). Calculated audible noise levels assume a overvoltage condition of 10 percent at the highest line elevation (3,000 feet).

3.4.11.3.1.2.4 AC Radio Noise Calculation Results

Radio noise calculations were performed for both AC transmission line interconnection designs for rainy and fair weather conditions. Table 3.4-43 presents a summary of the calculated radio noise at the ROW edges and for the maximum noise within the ROW at 500kHz for both weather conditions. Table 3.4-43 also presents calculated 500kHz radio noise at 50 feet from the outside conductor for comparison with the IEEE Standard. Calculated radio noise levels vary, depending upon the line configuration and weather conditions. As shown in Table 3.4-43, calculated radio noise levels at 50 feet from the outside conductor comply with the IEEE 61 dB:V/m threshold in fair weather conditions. Figure 3.4-41 presents a graph of the calculated radio noise levels for each AC line configuration in rainy weather, adjusted to the 500kHz reference level. Figure 3.4-42 presents a corresponding graph of the calculated radio noise levels for fair weather (adjusted to the 500kHz reference level).

Table 3.4-43:
Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated Radio Noise (dB:V/m) at 500kHz (Rainy/Fair Weather)[1]						
	-100 Feet from CL	-50 Feet from Outside Conductor	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+50 Feet from Outside Conductor	+100 Feet from CL
Single Circuit Monopole	65.3/48.3	71.3/54.3	69.5/52.5	85.9/68.9	69.9/52.9	72.5/55.5	65.8/48.8
Single Circuit Lattice	65.8/48.8	71.0/54.0	71.9/54.9	88.1/71.1	71.9/54.9	71.0/54.0	65.8/48.8

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline

It is difficult to determine whether the radio noise produced by a transmission line or any other source would cause unacceptable interference without knowing broadcast signal strengths at various locations of interest along the possible line routes.

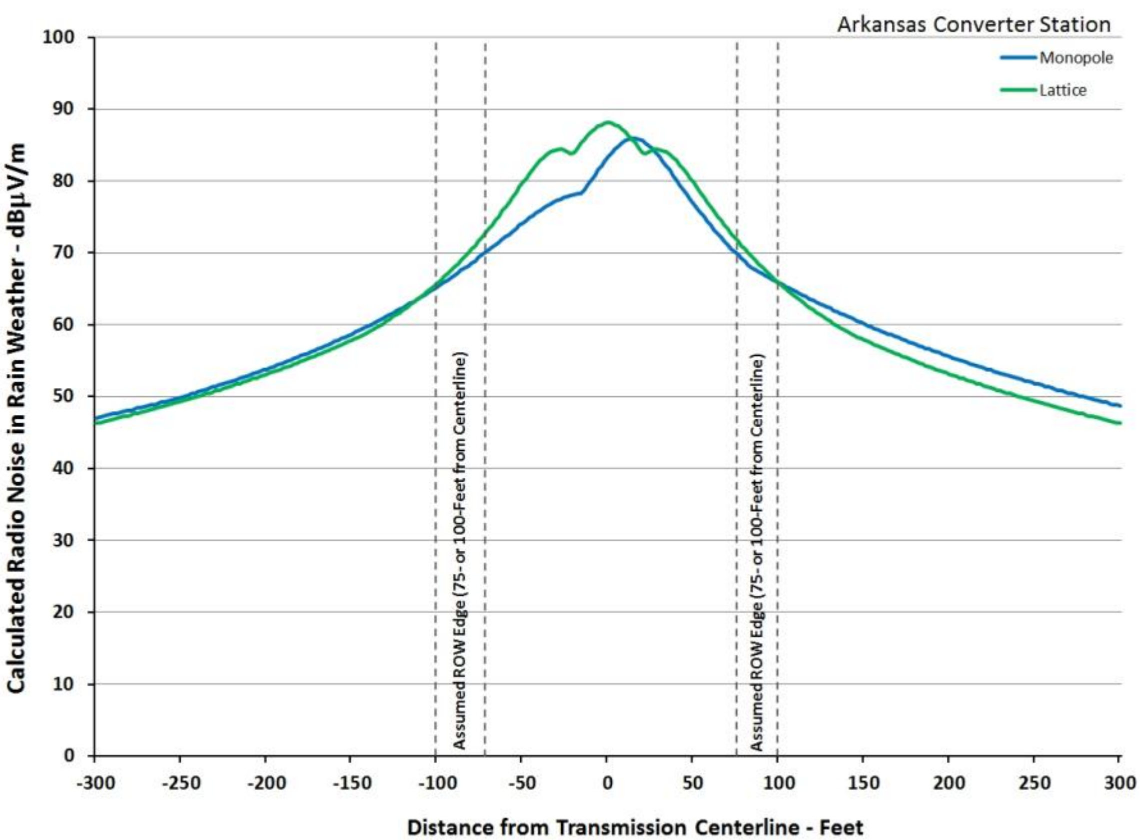


Figure 3.4-41: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Rainy Weather)

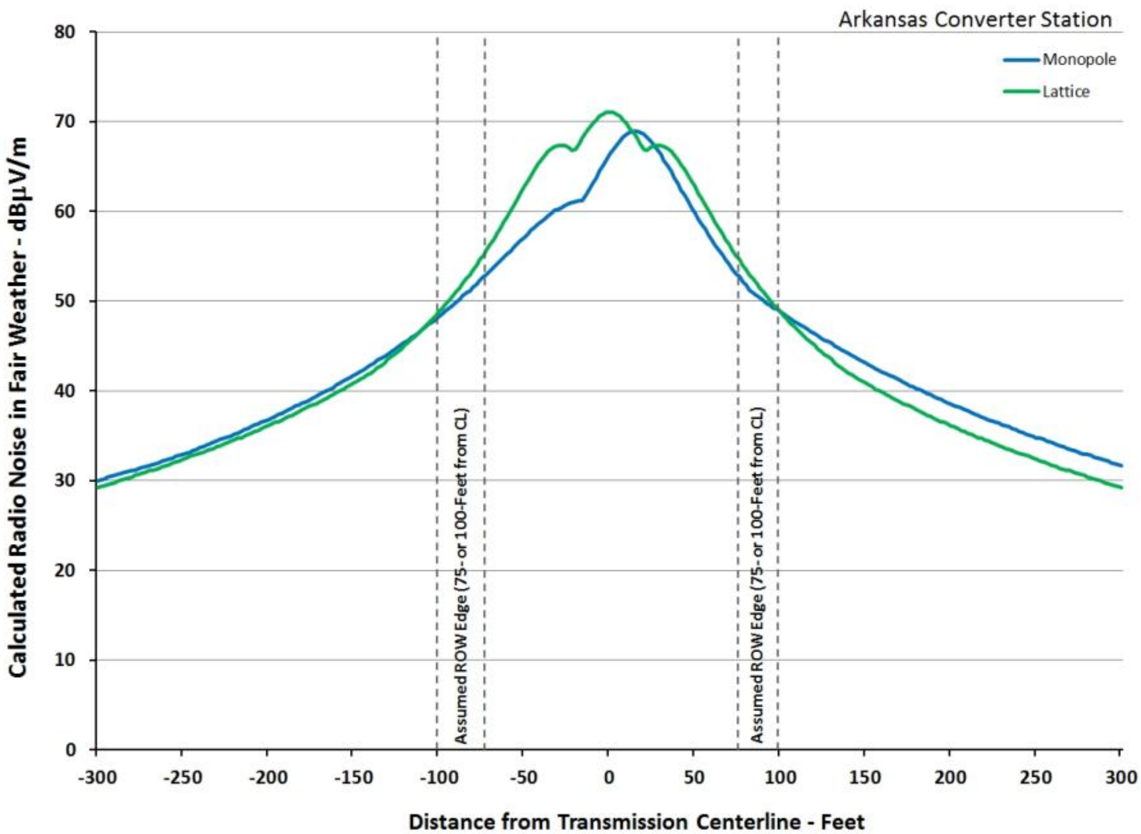


Figure 3.4-42: Calculated Radio Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Fair Weather)

3.4.11.3.1.2.5 AC Television Noise Calculation Results

Television noise calculations were performed for both AC transmission line interconnections for rainy weather conditions. Table 3.4-44 presents a summary of the calculated television noise at the ROW edges and for the maximum noise within the ROW for the 75MHz reference level. Calculated television noise levels vary, depending upon the line configuration. Figure 3.4-43 presents a graph of the calculated television noise levels for each AC line configuration in rainy weather.

Table 3.4-44:
Calculated Television Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated Television Noise (dB:V/m) at 75MHz for Rainy Weather[1]				
	-100 Feet from CL	-75 Feet from CL	Maximum on ROW	+75 Feet from CL	+100 Feet from CL
Single Circuit Monopole	23.9	25.9	38.3	29.1	26.4
Single Circuit Lattice	27.2	29.5	40.5	29.5	27.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

1 Edges of the ROW have not been established and are assumed to be either 75 feet or 100 feet from centerline.

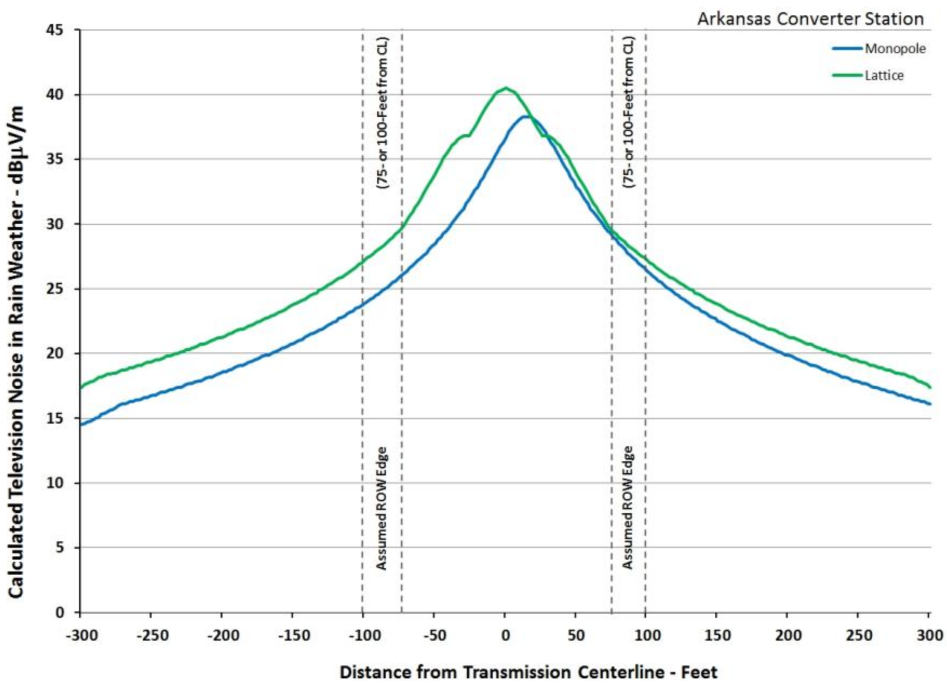


Figure 3.4-43: Calculated Television Noise for 500kV AC Transmission Line Interconnections to Arkansas Converter Station (Rainy Weather)

As with radio noise interference, it is difficult to determine whether the television noise level produced by a transmission line would cause unacceptable interference. However, the new digital broadcast system technology for radio and television should provide better coverage and immunity to transmission line noise than analog television signals. No interference resulting from corona-generated noise would be expected for digital signals broadcast at frequencies above 1GHz from satellites (EPRI 2006a).

3.4.11.3.1.2.6 Ozone Calculation Results

Ozone levels for both AC transmission line interconnections were calculated for rainy weather conditions. Table 3.4-45 presents a summary of the calculated maximum ozone concentrations at ground level within 300 feet of the transmission centerline. Maximum ozone levels are far below the EPA standard of 75 ppb for all three line design configurations.

Table 3.4-45:
Calculated Ozone Levels for 500kV AC Transmission Line Interconnections to Arkansas Converter Station

500kV AC Transmission Line Configuration	Calculated Ozone (ppb)
	Maximum within +/-300 Feet of CL
Single Circuit Monopole	0.1
Single Circuit Lattice	0.2

CL = Centerline; since the precise ROW width has not yet been determined, the ROI for analysis is 300-feet on either side of a representative centerline.

3.4.11.3.1.3 Decommissioning Impacts

There are no electrical effects associated with the decommissioning of the Arkansas converter station. Once decommissioned, there would be no electrical energy to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.3.2 HVDC Alternative Routes

This section describes the electrical effects associated with the HVDC alternative routes. Electrical effects would only be present during operation and maintenance of the transmission line. Electrical facilities need to be energized to create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference. Electrical effects would not be present during the construction and decommissioning phases of the project.

Existing facilities are present within these alternative transmission line routes, some of which already create electrical effects within the environment. Table 3.4-46 presents the number of existing AC transmission lines that parallel alternative HVDC transmission line routes as well as nearby communication facilities (which are existing radio-frequency sources) within a 1,000-foot corridor for each proposed route alternative. Table 3.4-46 also presents a summary of the number of existing building structures (residences, agricultural buildings, churches, and schools) within the same 1,000-foot corridor for each HVDC transmission line alternative route.

Table 3.4-46:
Occurrence of Existing Facilities along HVDC Alternative Routes

HVDC Alternative Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot Corridor (Residential/ Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot Corridor (Quantity and Type)[2]
Region 1			
Alternative Route 1-A	2 (115-345kV)	7/38/1/0	1 (PM)
Alternative Route 1-B	2 (69-345kV)	3/15/0/0	0
Alternative Route 1-C	1 (69kV)	6/16/0/0	0
Alternative Route 1-D	1 (69kV)	9/12/0/0	0
Region 2			
Alternative Route 2-A	1 (115kV)	5/6/0/0	0
Alternative Route 2-B	1 (115kV)	2/10/0/0	0
Region 3			
Alternative Route 3-A	0	13/13/0/0	0
Alternative Route 3-B	1 (69kV)	26/29/0/0	0
Alternative Route 3-C	6 (115-161kV)	102/69/0/0	5 (CM, AS)
Alternative Route 3-D	3 (115-161kV)	40/8/0/0	0
Alternative Route 3-E	4 (69-161kV)	20/0/0/0	0
Region 4			
Alternative Route 4-A	1 (69kV)	103/77/0/0	0
Alternative Route 4-B	1 (69kV)	107/89/0/0	0
Alternative Route 4-C	0	6/0/0/0	0
Alternative Route 4-D	0	67/54/1/0	0
Alternative Route 4-E	4 (161kV)	61/40/0/0	4 (MT)

Table 3.4-46:
Occurrence of Existing Facilities along HVDC Alternative Routes

HVDC Alternative Route	Parallels Existing AC Transmission Lines (Quantity and Voltage Range)	Existing Building Structures within 1,000-Foot Corridor (Residential/ Agricultural/Church/School)[1]	Existing Communication Facilities Within 1,000-Foot Corridor (Quantity and Type)[2]
Region 5			
Alternative Route 5-A	0	19/15/0/0	0
Alternative Route 5-B	2 (138-500kV)	54/55/1/0	2 (PM)
Alternative Route 5-C	0	11/3/0/0	0
Alternative Route 5-D	1 (500kV)	50/8/0/0	2 (PM, AS)
Alternative Route 5-E	2 (138-500kV)	24/15/1/0	0
Alternative Route 5-F	2 (138-500kV)	20/8/0/0	0
Region 6			
Alternative Route 6-A	0	6/0/0/0	0
Alternative Route 6-B	1 (161kV)	2/1/0/0	0
Alternative Route 6-C	0	16/1/0/0	0
Alternative Route 6-D	0	0/0/0/0	0
Region 7			
Alternative Route 7-A	1 (500kV)	12/6/0/0	1 (CM)
Alternative Route 7-B	0	10/2/0/0	1 (PM)
Alternative Route 7-C	2 (161kV)	44/16/2/0	2 (PM,AS)
Alternative Route 7-D	1 (500kV)	30/4/0/0	0

PM—Private Land Mobile, TV—TV National Television System Committee (NTSC), MT-Microwave Tower, AS—Antenna Structure, CM—Commercial Land Mobile

1 GIS Data Source: Clean Line (2013a, 2013b), Tetra Tech (2014a))

2 GIS Data Source: FCC (2012)

3.4.11.3.2.1 Construction Impacts

No electrical effects would be associated with construction of the ±600kV HVDC overhead electric transmission line along any of the HVDC alternative routes, because these facilities would not be energized during construction.

3.4.11.3.2.2 Operations and Maintenance Impacts

Section 3.4.11.2.3 describes the results of the modeling calculations for electrical effects for the two proposed DC transmission line configurations.

3.4.11.3.2.2.1 Summary of Impacts for the DOE Alternative Transmission Lines

Based on an evaluation of research and guidelines recommended by various agencies, it is unlikely that the DOE alternative transmission lines would pose a known threat to human health (reference Section 3.4.11.2.1.2.2.7). In addition, the likelihood of annoyance to landowners by audible noise from the line or interference to AM radio or television reception is small.

While a variety of electronic devices are known to affect the operation of pacemakers and ICDs, transmission lines have not been reported to produce functional disturbances to these devices. There is a possibility that induced potentials on the leads of these devices by AC electric fields on the ROW could affect the operation of these devices, but the clinical significance of such changes appears small. Persons who are concerned should contact their physician to ascertain the immunity of their device to this potential source of interference.

3.4.11.3.2.3 Decommissioning Impacts

No electrical effects would be associated with the decommissioning of the ±600kV HVDC overhead electric transmission line. Once decommissioned, no electrical energy would be generated that would create electrical effects such as electric and magnetic fields, audible noise, and radio and television interference.

3.4.11.4 Best Management Practices

Based upon the EPMs already proposed by the Applicant, no BMPs are suggested.

3.4.11.5 Unavoidable and Adverse Impacts

Impacts concerning electrical effects are discussed in Section 3.4.6. Unavoidable and potentially adverse impacts are the electrical effects (electric and magnetic fields, radio and television noise, audible noise, ozone, and air ions) associated with the operation of overhead HVDC and/or AC transmission lines. These effects are present within, and to a more limited extent outside of, the transmission line ROW. Outside of the ROW, calculated electrical effects for the Project are limited to levels that comply with associated standards and guidelines.

3.4.11.6 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of resources associated with electrical effects and the Project.

3.4.11.7 Relationship between Local Short-term Uses and Long-term Productivity

No short-term uses or resource removal exist that would affect long-term productivity associated with electrical effects from the Project.

3.4.11.8 Impacts from Connected Actions

3.4.11.8.1 Wind Energy Generation

Electricity for numerous wind energy generation facilities may be transported across the Project's ±600kV HVDC overhead electric transmission line. Electrical equipment associated with wind farms includes wind turbine generators (rotor blades connected to a turbine generator/drive train and supported on a steel tower approximately 200 to 330 feet above ground level), underground collection cables to carry lower-voltage electricity from individual wind turbine generators to an electric transformer (usually located within a substation), electric transformers (to convert lower-voltage electricity to higher-voltage), and AC transmission lines to connect the wind power generation to the electrical grid. Often substations will also contain circuit breakers, capacitor banks, relaying equipment, high voltage bus work, metal clad switchgear, and related electrical equipment.

An evaluation of the electrical effects associated with wind energy generation facilities only includes AC magnetic fields. No DC electric or magnetic fields from Project sources are present, since the wind farm electrical system is strictly an AC system. Because the wind turbine generator is housed within a steel structure, and the collection cables are located either within the steel tower structure or underground (i.e., shielded); there are no AC corona effects (audible noise, radio and television noise, and ozone generation) associated with this equipment. Likewise, there are no AC electric field effects. While audible noise and interference may be present from the generator itself and/or the turning rotor blades, this does not result from the flow of electricity and is therefore not an electrical effect. The only remaining electrical effect under consideration then is the AC magnetic field.

A wind turbine generator is located at the top of the steel support tower, typically 200 to 300 feet (or more) above ground level, and housed within the structural steel tower. This arrangement results in very low (if any) magnetic field at ground level due to the generator (McCallum et al. 2014). The collection cables are located either within the steel support tower or collocated together within an underground duct. Placing the cables in close proximity to each other increases the magnetic field cancellation between cables (because the magnetic field produced by a set of conductors is proportional to the average spacing between conductors) (EPRI 1999), so a magnetic field may be present directly above an underground cable (depending upon a number of parameters, including the loading, phase configuration, grounding configuration, and depth of the cables). Nevertheless, the magnetic field will typically decrease very quickly with distance away from cable (Naikun 2014), much more so than from overhead transmission lines. Magnetic fields from these cables will usually be located within the wind farm facility (connecting the wind farm turbines to the substation), so it is not anticipated that significant magnetic fields will be associated with the wind farm generation system itself outside the ROI (SCC 2011; Rideout et al. 2010; Fortin et al. 2013).

For substations, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the substations (which are addressed within the AC collection system). Some types of substation equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise). These effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Because the dominant sources of electrical effects are associated with the overhead transmission lines, not substation equipment, an evaluation of electrical effects for substations associated with wind generation facilities was not performed.

3.4.11.8.2 Optima Substation

For substations, the dominant sources of electrical effects are the overhead transmission lines entering and exiting the stations. Some types of substation equipment can potentially be a source of electrical effects (for example, power transformers can produce audible noise, and converter equipment can produce radio noise, etc.).

3.4.11.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

Upgrades required to interconnect into the TVA transmission grid could contribute to AC electric fields, AC magnetic fields, audible noise caused by corona discharge from the transmission line conductors, radio and television noise interference, and ozone. These effects are associated with energized AC transmission lines so electrical effects of concern would not occur during construction of the required TVA upgrades.

Electrical impacts from the new TVA 500kV transmission line would be expected to be similar to those described for the 500kV AC transmission lines associated with the Tennessee and Arkansas converter stations (Sections 3.4.11.2.1.2.2 and 3.4.11.3.1) and, perhaps to a lesser extent (due to the lower voltage), those described for the 345kV AC transmission lines associated with the Oklahoma convertor station and AC collection system (Sections 3.4.11.2.1.2.1 and 3.4.11.2.2). Lower impacts would be expected from the TVA upgrades to transmissions lines because the 161kV transmission lines that would be affected already exist. Impacts at or near ground level can vary substantially based on the height of the transmission structure and on the structure/line configuration as well as the electrical energy transmitted. The loading would also impact magnetic field levels.

Upgrades to substation equipment would also be made for the TVA interconnection, which would include modifications to existing substations on the terminal ends of the new line and upgrading terminal equipment at three existing 500kV and three existing 161kV substations (reference Section 2.5.2 for a complete description of these upgrades). For substations, the dominant sources of electrical effects are typically the overhead transmission lines entering and exiting the substations (rather than substation equipment). However, some types of substation equipment can potentially be a source of electrical effects (for example, power transformers can produce long-term audible noise). These long-term effects can be reduced or eliminated by the use of filtering equipment, sound walls, and other methods. Because the dominant sources of electrical effects are typically associated with the overhead transmission lines, not substation equipment, an evaluation of electrical effects for substation upgrades associated with the TVA interconnection was not performed.

3.4.11.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not move forward. The existing electrical environment would remain in its present condition. DC electric and magnetic fields would always be present because of other existing facilities and natural sources. If the ±600kV HVDC overhead electric transmission line is not constructed, then no additional DC electric or magnetic fields would be introduced along any of the Project routes. Because AC electric fields, audible noise, and radio and television interference attributable to corona activity from overhead AC power lines already exist along portions of the Project routes, and voltage on a power line is held relatively constant, these existing electrical effects would remain unchanged. AC magnetic fields attributable to existing overhead AC power lines vary with loading on each of the lines and would continue to do so.

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Tables

Figures Presented in Appendix A

3.5 Environmental Justice

This section presents the affected environment and provides an assessment of the potential for disproportionately high and adverse environmental or human health effects on minority and/or low-income populations from the Plains & Eastern Project, in accordance with Executive Order (EO) 12898.

Minority populations include individuals who are Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, other non-white race, or persons of two or more races and Hispanic or Latino. Low-income populations include individuals living below the poverty line, as defined by the U.S. Census Bureau.

3.5.1 Regulatory Background

Environmental justice laws and regulations relevant to the resources in the ROI are summarized in Table 3.5-1.

Table 3.5-1:
Legal Authorities Addressing Environmental Justice

Statute/Regulation	Applicability to the Project
Federal	
EO 12898 (59 FR 7629): Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations as amended by EO 12948	Requires each federal agency to make the achievement of environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The EO further directs agencies to conduct their programs and activities in a manner that does not have the effect of excluding persons from participation in them, denying persons the benefits of them, or subjecting persons to discrimination because of their race, color, or national origin.

3.5.2 Data Sources

This environmental justice analysis uses the U.S. Census Bureau 2010 Census of Population and Housing and the 2011 American Community Survey Demographic and Housing Estimates for population and income data for Census Block and Block Groups that are wholly or partially within the ROI.

The U.S. Census Bureau has defined levels of statistical geographic entities to present data from the decennial census and American Community Survey. Counties are divided into Census Tracts, Census Tracts into Census Block Groups, and Census Block Groups into Census Blocks, the smallest statistical area the Census uses to report sample data. Figure 3.5-1 in Appendix A shows the Census Block Groups with low income populations in the ROI.

3.5.3 Region of Influence

The ROI for environmental justice considers the area where potential impacts could occur. The ROI for identifying low-income and minority populations consists of Census Block Groups or Census Blocks, respectively, within the counties intersected by the Project as described in Section 3.1. Census Blocks within the ROI are used to identify potential minority populations while Census Block Groups are used to identify potential low-income populations. Census Block Groups are used in the analysis of low-income populations because income data are not collected/not available at the Census Block level. Poverty thresholds are based on the Office of Management and Budget's Statistical Policy Directive 14.

Census Blocks are statistical areas bounded by visible features, such as streets, roads, streams, and railroad tracks, and by nonvisible boundaries, such as property lines and city, township, school district, and county limits and short line-of-sight extensions of streets and roads.

Census Block Groups are generally defined to contain between 600 and 3,000 people and usually cover a contiguous area. Census Block Groups do not cross state, county, or census tract boundaries, but may cross boundaries of any other geographic entity. Census data on income are reported only for a sample of the population and therefore are reported only at the Census Block Group level.

3.5.3.1 Region of Influence for the Applicant Proposed Project

The environmental justice ROI for the Applicant Proposed Project consists of Census Blocks and Census Block Groups in the counties where the proposed facilities would be located. The ROI is divided into seven regions for the purposes of this analysis. Table 3.5-2 presents the counties within the environmental justice ROI.

Table 3.5-2:
Counties Potentially Affected by the Applicant Proposed Project by Region

Region	State	County[1]
1	Oklahoma	Cimarron, Texas, Beaver, Harper
	Texas	Hansford, Ochiltree, Sherman
2	Oklahoma	Woodward, Major, Garfield
3	Oklahoma	Garfield[2], Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, Muskogee[2]
4	Oklahoma	Muskogee[2], Sequoyah
	Arkansas	Crawford, Franklin, Johnson, Pope[1]
5	Arkansas	Pope[2], Conway, Faulkner, Van Buren, Cleburne, White, Jackson
6	Arkansas	Jackson[2], Poinsett[2], Cross
7	Arkansas	Poinsett, Mississippi
	Tennessee	Tipton, Shelby

1 Counties are generally listed from west to east by region.
2 Counties located in more than one region.

3.5.3.2 Region of Influence for the DOE Alternatives

The ROI for the DOE Alternatives consist of the same counties as those listed for the Applicant Proposed Project.

3.5.3.3 Region of Influence for Connected Actions

3.5.3.3.1 Wind Energy Generation

Census Block Groups are used for the wind energy generation analysis because the exact location of wind farms and turbines has not been identified; therefore, larger geographic units for the environmental justice analysis were used. The ROI for wind energy generation includes Census Block Groups within the counties that contain WDZs. These counties include Beaver, Cimarron, and Texas counties in Oklahoma and Hansford, Ochiltree, and Sherman counties in Texas.

3.5.3.3.2 Optima Substation

The ROI for the future Optima Substation includes Census Blocks and Census Block Groups in Texas County, Oklahoma.

3.5.3.3.3 TVA Upgrades

The ROI for evaluation of impacts on environmental justice from the TVA upgrades is the same as that identified in Section 3.1.1.

3.5.4 Affected Environment

The affected environment for environmental justice analysis includes Census Blocks and Census Block Groups (described in Section 3.5.3) in Texas, Oklahoma, Arkansas, and Tennessee. The sections below identify low-income and minority populations within the affected environment.

For the analysis in this EIS, a population is defined as minority population in terms of race and ethnicity if 50 percent or more of the population within the Census Block is minority or if the Census Block population has a “meaningfully greater” percentage of minorities compared to the entire county. For this analysis “meaningfully greater” is defined as 10 percentage points higher than the minority population of the whole county.

Low-income populations are identified as low-income populations if 20 percent or more of the households within the Census Block Group live below the poverty level. Poverty thresholds vary based on the size of the family and age of its members, but do not vary based on geographic region. The weighted average threshold ranges from $11,484 for a one-person household to $46,572 for a household with nine or more family members (GIS Data Source: USCB 2011).

3.5.4.1 Texas

The 2-mile-wide corridor for the AC collection system routes in Texas includes 246 Census Blocks and 5 Census Block Groups in three counties in Texas. A majority of the Census Blocks and Census Block Groups have demographics similar to their respective counties.

Table 3.5-3 presents data on Census Blocks with identified minority populations, and Table 3.5-4 presents data on Census Block Groups with identified low-income populations.

Table 3.5-3:
Race and Ethnicity Comparison for Census Blocks in the AC Collection System Routes in Texas

Census Block by County[1]	Total Population	Minority	AC Collection System Route
Ochiltree	10,147	49.80%	
Census Tract 950100, Block 2036	11	54.50%	NE-2, SE-3
Sherman	3,019	40.60%	
Census Tract 650200, Block 1179	12	100.00%	SW-2

1 Blocks presented represent identified minority populations as defined in Section 3.5.4.
Source: USCB (2011)

Table 3.5-4:
Poverty Status for Census Block Groups in the AC Collection System Routes in Texas

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	AC Collection System Route
Hansford	1,895	13.3	$52,610	
Census Tract 9503, Block Group 1	417	28.5	$40,179	SE-1

1 Block Groups presented represent identified low-income and minority populations as defined in Section 3.5.4.
GIS Data Source: USCB (2011)

Two Census Blocks in the AC collection system routes were identified as having minority populations that are 50 percent or more of the population within the Census Block (Table 3.5-3). One Census Block Group was identified as having populations (Table 3.5-4) of low income and poverty.

3.5.4.2 Oklahoma

The 1,000-foot-wide corridor for the Applicant Proposed Route includes 856 Census Blocks and 51 Census Block Groups in 15 counties in Oklahoma. A majority of the Census Blocks and Census Block Groups have demographics similar to their respective counties and are predominantly white.

The 2-mile-wide corridor for the AC Collection System Route includes 1,075 Census Blocks and eight Census Block Groups in Beaver, Cimarron, and Texas counties in Oklahoma. The population in all three counties is predominantly white. Of the three counties, Texas County has the highest minority population with more than 40 percent of the county's population identifying as Hispanic.

Nineteen Census Blocks and one Census Block Group were identified in the Oklahoma Converter Station Siting Area.

Table 3.5-5 presents data on Census Blocks with identified minority populations and Table 3.5-6 presents data on Census Block Groups with identified low-income populations.

Table 3.5-5:
Race and Ethnicity Comparison for Census Blocks in the ROI in Oklahoma

Census Block by County[1]	Total Population	Minority	Project Feature
Creek	69,450	21.60%	
Census Tract 0211.02, Block 2087	11	54.60%	Applicant Proposed Route (Region 3), Alternative Route 3-A, 3-B, 3-C
Muskogee	70,593	41.30%	
Census Tract 0011.00, Block 1086	17	64.70%	Applicant Proposed Route (Region 3), Alternative Route 3-C
Census Tract 0011.00, Block 1130	28	57.20%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 1148	25	64.00%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 1275	13	100.00%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 2038	19	57.90%	Applicant Proposed Route (Region 3)
Census Tract 0011.00, Block 2107	10	70.00%	Applicant Proposed Route (Region 3)
Census Tract 0013.00, Block 4107	26	53.80%	Applicant Proposed Route (Region 3)

Table 3.5-5:
Race and Ethnicity Comparison for Census Blocks in the ROI in Oklahoma

Census Block by County[1]	Total Population	Minority	Project Feature
Census Tract 0016.00, Block 3147	27	77.80%	Applicant Proposed Route (Region 3), Alternative Route 3-D
Census Tract 0016.00, Block 3148	10	90.00%	Applicant Proposed Route (Region 3)
Okmulgee	39,766	35.00%	
Census Tract 0006.00, Block 2121	20	45.00%	Applicant Proposed Route (Region 3)
Sequoyah	42,074	68.50%	
Census Tract 0301.04, Block 3080	20	50.00%	Applicant Proposed Route (Region 4), Alternative Route 4-A, AR 4-D,
Census Tract 0302.02, Block 2110	96	50.90%	Applicant Proposed Route (Region 4), Alternative Route 4-B
Census Tract 0302.02, Block 2135	22	50.00%	Applicant Proposed Route (Region 4)
Woodward	20,105	16.70%	
Census Tract 9532.00, Block 1130	25	40.00%	Applicant Proposed Route (Region 2)
Texas County	20,218	46.10%	
Census Tract 9506.00, Block 5069	10	50.00%	AC Collection System Route NE-1
Census Tract 9507.00, Block 2435	19	57.90%	AC Collection System Route E-2, NW-1
Census Tract 9507.00, Block 2614	11	72.70%	AC Collection System Route E-1
Census Tract 9507.00, Block 2735	11	63.60%	AC Collection System Route E-2, AC E-3, AC SE-1, AC SE-3
Census Tract 9507.00, Block 2774	13	100.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2798	10	50.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2811	10	50.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2813	10	100.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2825	11	100.00%	AC Collection System Route E-1
Census Tract 9507.00, Block 2826	13	100.00%	AC Collection System Route E-1

1 Blocks presented represent identified minority populations as defined in Section 3.5.4. Project features not listed indicate that no minority populations were identified within that project feature. For example, the Oklahoma Converter Station is not listed because no minority populations were identified within the Oklahoma Converter Station Siting Area.

Source: USCB (2011)

Table 3.5-6:
Poverty Status for Census Block Groups in the ROI in Oklahoma

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Creek	26,373	14.2	$42,950	
Census Tract 210, Block Group 1	393	24.4	$36,250	Applicant Proposed Route (Region 3), AC Collection System Route 3-C
Major	3,185	10.4	$48,012	
Census Tract 9553, Block Group 2	450	22.4	$49,074	Applicant Proposed Route (Region 2)
Muskogee	27,056	21.1	$37,990	
Census Tract 12, Block Group 2	214	25.2	$22,016	Applicant Proposed Route (Region 3)

Table 3.5-6:
Poverty Status for Census Block Groups in the ROI in Oklahoma

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Census Tract 14, Block Group 5	553	24.1	$39,015	Applicant Proposed Route (Region 3)
Census Tract 15, Block Group 1	489	23.3	$39,207	Applicant Proposed Route (Region 3)
Okmulgee	15,193	19.4	$39,324	
Census Tract 7, Block Group 1	494	21.3	$57,083	Applicant Proposed Route (Region 3), Alternative Route 3-C
Sequoyah	15,520	19.0	$38,292	
Census Tract 302.02, Block Group 2	849	21.4	$36,111	Applicant Proposed Route (Region 4), Alternative Route 4-A, AR 4-B
Texas	7,122	14.6	$46,631	
Census Tract 9509, Block Group 1	630	22.2	$40,833	AC Collection System Route NE-1, AC NW-2

1 Block Groups presented represent identified low-income populations as defined in Section 3.5.4. Project features not listed indicate that no low-income and minority populations were identified within that project feature. For example, the Oklahoma Converter Station is not listed because no low-income and minority populations were identified within the Oklahoma Converter Station Siting Area.
Source: USCB (2011)

Fifteen Census Blocks in the Applicant Proposed Route and five Census Blocks in the HVDC alternative routes were identified as having greater minority populations (Table 3.5-5). Seven Census Block Groups in the Applicant Proposed Route and three Census Block Groups in the HVDC alternative routes were identified as having low-income populations in terms of income and poverty (Table 3.5-6). Ten Census Blocks were identified in the AC collection system routes as having a greater minority population (Table 3.5-5). One Census Block Group was identified in the AC collection system routes as having low-income populations in terms of income and poverty (Table 3.5-6).

Only one of the 19 Census Blocks in the Oklahoma Converter Station Siting Area in Texas County, Oklahoma, was populated. There are no minority or low-income populations in the Oklahoma Converter Station Siting Area.

3.5.4.3 Arkansas

The 1,000-foot-wide corridor for the Applicant Proposed Route and HVDC Alternative Routes includes 557 Census Blocks and 51 Census Block Groups in 13 counties in Arkansas. A majority of the Census Blocks has demographics similar to their respective counties and is predominantly white.

One hundred thirty Census Blocks and two Census Block Groups occur in the Arkansas Converter Station Alternative Siting Area.

Table 3.5-7 presents data on Census Blocks with identified minority populations and Table 3.5-8 presents data on Census Block Groups with identified low-income populations.

Table 3.5-7:
Race and Ethnicity Comparison for Census Blocks in the ROI in Arkansas

Census Block by County[1]	Total Population	Minority	Project Features
Cleburne	25,788	4.30%	
Census Tract 4805.02, Block 1020	53	15.10%	Applicant Proposed Route (Region 5)
Conway	21,164	17.70%	
Census Tract 9501.00, Block 2036	53	39.60%	Applicant Proposed Route (Region 5)
Census Tract 9502.00, Block 1088	55	40.00%	Applicant Proposed Route (Region 5), Arkansas Converter Station
Census Tract 9502.00, Block 1099	51	29.40%	Applicant Proposed Route (Region 5)
Cross	17,992	25.70%	
Census Tract 9502.00, Block 2041	20	80.00%	Applicant Proposed Route (Region 6)
Franklin	18,157	6.30%	
Census Tract 9501.00, Block 2194	19	36.90%	Applicant Proposed Route (Region 4)
Census Tract 9501.00, Block 2081	17	76.50%	Applicant Proposed Route (Region 4)
Jackson	17,969	21.10%	
Census Tract 4804.00, Block 3084	15	60.00%	Applicant Proposed Route (Region 6)
Johnson	25,408	16.10%	
Census Tract 9518.00, Block 1019	10	50.00%	Applicant Proposed Route (Region 4)
Pope	61,166	12.80%	
Census Tract 9510.00, Block 2037	16	37.50%	Applicant Proposed Route (Region 4)
Van Buren	17,255	5.70%	
Census Tract 4604.00, Block 3055	11	18.20%	Applicant Proposed Route (Region 5)

1 Blocks presented represent identified minority populations as defined in Section 3.5.4. Project features not listed indicate that no minority populations were identified within that project feature.

Source: USCB (2011)

Table 3.5-8:
Poverty Status for Census Block Groups in the ROI in Arkansas

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Conway	8,137	21.9	$31,890	
Census Tract 9501, Block Group 1	580	22.9	$53,056	Applicant Proposed Route (Region 5), Alternative Route 5-B, Arkansas Converter Station
Census Tract 9502, Block Group 1	455	20.7	$43,917	Applicant Proposed Route (Region 5), Arkansas Converter Station
Crawford	23,174	17.6	$40,409	
Census Tract 204.2, Block Group 3	329	28.6	$49,792	Applicant Proposed Route (Region 4)
Census Tract 206, Block Group 5	549	28.1	$36,098	Applicant Proposed Route (Region 4)
Cross	6,823	16.7	$38,432	
Census Tract 9501, Block Group 1	554	32.9	$41,696	Applicant Proposed Route (Region 6)

Table 3.5-8:
Poverty Status for Census Block Groups in the ROI in Arkansas

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Census Tract 9502, Block Group 1	459	22.9	$37,632	Applicant Proposed Route (Region 6)
Census Tract 9502, Block Group 2	370	21.1	$37,098	Applicant Proposed Route (Region 6), Alternative Route 6-D
Census Tract 9503, Block Group 1	321	24.0	$43,466	Applicant Proposed Route (Region 6)
Franklin	6,763	20.1	$34,819	
Census Tract 9502, Block Group 1	756	20.8	$39,274	Applicant Proposed Route (Region 4), Alternative Route 4-B, AR 4-E
Census Tract 9502, Block Group 2	398	54.5	$20,000	Applicant Proposed Route (Region 4)
Jackson	6,383	25.1	$31,352	
Census Tract 4805, Block Group 1	721	25.0	$39,836	Applicant Proposed Route (Region 6), Alternative Route 5-D
Mississippi	17,136	26.1	$34,267	
Census Tract 113, Block Group 2	597	20.8	$38,056	Applicant Proposed Route (Region 7), Alternative Route 7-A
Poinsett	9,427	26.0	$31,939	
Census Tract 4902, Block Group 1	375	21.6	$51,435	Applicant Proposed Route, Alternative Route 6-C, AR 6-D
Pope	22,599	18.9	$40,325	
Census Tract 9507, Block Group 2	463	23.1	$21,518	Applicant Proposed Route (Region 5), Alternative Route 5-A
Census Tract 9510, Block Group 1	713	23.6	$55,163	Applicant Proposed Route (Region 5), Alternative Route 5-B, Arkansas Converter Station
Census Tract 9510, Block Group 2	987	23.0	$41,007	Applicant Proposed Route (Region 5), Alternative Route 5-A
Van Buren	7,097	24.9	$32,906	
Census Tract 4604, Block Group 2	421	23.0	$34,844	Applicant Proposed Route (Region 5), Alternative Route 5-E
Census Tract 4604, Block Group 3	442	20.6	$55,476	Applicant Proposed Route (Region 5), Alternative Route 5-E
White	29,529	16.4	$41,618	
Census Tract 702, Block Group 2	737	25.1	$42,550	Applicant Proposed Route (Region 5), Alternative Route 5-B, AR 5-C, AR 5-E, AR 5-F

1 Block Groups presented represent identified low-income populations as defined in Section 3.5.4. Project features not listed indicate that no low-income and minority populations were identified within that project feature.
GIS Data Source: USCB (2011)

Eleven Census Blocks in the Applicant Proposed Route were identified as having a greater minority population (Table 3.5-7) and 19 Census Block Groups were identified as having low-income populations (Table 3.5-8).

One Census Block in the Arkansas Converter Station Alternative Siting Area was identified as having minority populations (Table 3.5-7), and three Census Block Groups were identified as having low-income populations (Table 3.5-8).

3.5.4.4 Tennessee

The 1,000-foot-wide corridor for the Applicant Proposed Route includes 33 Census Blocks and 8 Census Block Groups in two counties in Tennessee. A majority of the 33 Census Blocks have demographics similar to their respective counties.

Table 3.5-9 presents data on Census Blocks with identified minority populations and Table 3.5-10 presents data on Census Block Groups with identified low-income populations.

Table 3.5-9:
Race and Ethnicity Comparison for Census Blocks in the ROI in Tennessee

Census Block by County[1]	Total Population	Minority	Project Features
Tipton	60,462	23.60%	
Census Tract 0401.00, Block 2001	307	54.00%	Applicant Proposed Route (Region 7), Alternative Route 7-A, AR 7-B, AR 7-C
Census Tract 0401.00, Block 3014	190	34.20%	Applicant Proposed Route (Region 7), Alternative Route 7-C
Census Tract 0403.03, Block 3006	63	65.10%	Applicant Proposed Route (Region 7), Alternative Route 7-C

1 Blocks presented represent identified minority populations as defined in Section 3.5.4. Project features not listed indicate that no minority populations were identified within that project feature.
Source: USCB (2011)

Table 3.5-10:
Poverty Status for Census Block Groups in the ROI in Tennessee

Census Block Group[1]	Total Households	Percentage of People Below Poverty	Household Median Income	Project Features
Shelby	340,394	20.1	$46,102	
Census Tract 202.10, Block Group 3	848	20.2	$32,933	Applicant Proposed Route (Region 7), Alternative Route 7-B, AR 7-C, Tennessee Converter Station
Tipton	21,578	15.3	$50,869	
Census Tract 401,Block Group 2	394	31.5	$46,722	Applicant Proposed Route (Region 7), Alternative Route 7-A, AR 7-B, AR 7-C

1 Block Groups presented represent identified low-income populations as defined in Section 3.5.4. Project features not listed indicate that no low-income populations were identified within that project feature.
GIS Data Source: USCB (2011)

Three Census Blocks in the Applicant Proposed Route and HVDC Alternative Routes were identified as having a greater minority population (Table 3.5-9), and two Census Block Groups were identified as having low-income populations (Table 3.5-10).

No Census Blocks were identified as having minority populations within the Tennessee Converter Station Siting Area in Shelby County or Tipton County, Tennessee. One Census Block Group was identified as having low-income populations (Table 3.5-10).

3.5.5 Regional Description

The following includes demographic and economic profiles of the counties within the Project. Table 3.5-11 presents demographic and economic profile of the counties and regions.

3.5.5.1 Region 1

Region 1, located in the Oklahoma Panhandle in Hansford, Ochiltree, and Sherman counties in Texas and Cimarron, Texas, Beaver, and Harper counties in Oklahoma, includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D. Figure 3.5-1a in Appendix A shows Census Block Groups containing low-income populations within Region 1.

3.5.5.2 Region 2

Region 2, located in the Oklahoma Central Great Plains in Woodward, Major, and Garfield counties in Oklahoma, includes Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. Figure 3.5-1b in Appendix A shows Census Block Groups containing low-income populations within Region 2.

3.5.5.3 Region 3

Region 3, located in the Oklahoma Cross Timbers in Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee counties in Oklahoma, includes Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. Figure 3.5-1c in Appendix A shows Census Block Groups containing low-income populations within Region 3.

3.5.5.4 Region 4

Region 4, located in the Arkansas River Valley in Sequoyah County in Oklahoma and Crawford, Franklin, and Johnson counties in Arkansas, includes Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. Figure 3.5-1d in Appendix A shows Census Block Groups containing low-income populations within Region 4.

3.5.5.5 Region 5

Region 5, located in Central Arkansas in Pope, Conway, Van Buren, Cleburne, Faulkner, White, and Jackson counties in Arkansas, includes Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. Figure 3.5-1e in Appendix A shows Census Block Groups containing low-income populations within Region 5.

3.5.5.6 Region 6

Region 6, located in the Cache River, Crowley's Ridge Area, and St. Francis Channel in Poinsett and Cross counties in Arkansas, includes Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Figure 3.5-1f in Appendix A shows Census Block Groups containing low-income populations within Region 6.

Table 3.5-11:
Demographic and Economic Profile of Counties and Regions

Region	County	2011 Total Population	White (%)	Black or African American (%)	American Indian and Alaska Native (%)	Asian (%)	Native Hawaiian and Other Pacific Islander Alone (%)	Some Other Race Alone (%)	Two or More Races (%)	Hispanic (%)	Minority (%)	Total Households	Percentage of Households Below Poverty (%)	Household Median Income (%)
1	Hansford, TX	5,524	55.72	0.52	0.00	0.69	0.27	0.00	1.00	41.80	44.28	1,895	13.30	$52,610
	Ochiltree, TX	10,147	50.17	0.41	0.55	0.33	0.00	0.00	1.80	46.73	49.83	3,735	21.60	$49,794
	Sherman, TX	3,019	59.42	0.53	0.00	0.26	0.00	0.00	0.76	39.02	40.58	1,015	14.00	$49,135
	Cimarron, OK	2,486	78.28	0.56	0.36	0.32	0.00	0.00	0.80	19.67	21.72	1,095	23.70	$35,440
	Texas, OK	20,218	53.89	1.10	0.47	1.54	0.00	0.15	2.00	40.84	46.11	7,122	14.60	$46,631
	Beaver, OK	5,586	77.93	0.64	1.02	0.18	0.00	0.00	1.79	18.44	22.07	2,150	13.20	$47,386
	Harper, OK	3,641	81.87	0.03	0.52	0.44	0.00	0.00	1.18	15.96	18.13	1,542	11.60	$44,850
	Region 1 Total	50,621	59.54	0.71	0.47	0.84	0.03	0.06	1.64	36.72	40.46	18,554	15.97	$47,386
2	Woodward, OK	20,105	83.42	1.05	2.67	0.79	0.01	0.37	2.05	9.63	16.58	7,558	12.40	$51,087
	Major, OK	7,530	88.07	0.28	2.67	0.40	0.00	0.49	1.24	6.85	11.93	3,185	10.40	$56,641
	Garfield, OK[1]	59,680	81.14	2.53	2.24	0.92	1.57	0.07	3.07	8.46	18.86	24,022	16.30	$41,688
	Region 2 Total	87,315	82.27	1.99	2.38	0.85	1.07	0.17	2.68	8.59	17.73	34,765	14.91	$51,087
3	Kingfisher, OK	14,928	80.73	1.25	3.76	0.11	0.04	0.00	1.43	12.67	19.27	5,662	10.40	$59,071
	Logan, OK	40,863	78.79	8.96	3.24	0.48	0.08	0.01	3.37	5.08	21.21	14,553	14.80	$50,249
	Payne, OK	76,291	79.79	3.46	3.46	3.57	0.02	0.08	3.12	3.87	17.59	29,731	23.20	$35,716
	Lincoln, OK	33,964	84.38	2.03	5.22	0.13	0.00	0.08	5.56	2.60	15.62	12,912	14.80	$41,763
	Creek, OK	69,450	78.53	2.08	6.38	0.42	0.15	0.10	9.16	3.16	21.47	26,373	14.20	$53,450
	Okmulgee, OK	39,766	64.94	8.70	12.49	0.17	0.04	0.05	10.21	3.40	35.06	15,193	19.40	$39,324
	Muskogee, OK[1]	70,593	58.72	11.36	13.30	0.58	0.00	0.03	10.93	5.10	41.30	27,056	21.10	$37,990
	Region 3 Total	345,855	73.90	5.81	7.26	1.09	0.05	0.06	6.94	4.32	25.52	131,480	18.22	$41,763

Table 3.5-11:
Demographic and Economic Profile of Counties and Regions

Region	County	2011 Total Population	White (%)	Black or African American (%)	American Indian and Alaska Native (%)	Asian (%)	Native Hawaiian and Other Pacific Islander Alone (%)	Some Other Race Alone (%)	Two or More Races (%)	Hispanic (%)	Minority (%)	Total Households	Percentage of Households Below Poverty (%)	Household Median Income (%)
4	Sequoyah, OK	42,074	65.32	1.88	10.11	0.54	0.00	0.00	18.58	3.56	34.68	15,520	19.00	$38,292
	Crawford, AR	61,336	86.89	1.36	1.11	1.49	0.00	0.07	3.11	5.98	13.11	23,174	17.60	$40,409
	Franklin, AR	18,157	93.72	0.78	0.76	0.24	0.00	0.00	2.39	2.11	6.28	6,763	20.10	$34,819
	Johnson, AR	25,408	83.87	1.50	0.98	0.32	0.13	0.02	1.33	11.85	16.13	9,626	19.90	$31,400
	Region 4 Total	146,975	81.04	1.46	3.62	0.86	0.02	0.03	7.14	5.82	18.96	55,083	18.70	$36,556
5	Pope, AR[1]	61,166	87.28	3.17	0.41	0.91	0.00	0.11	1.76	6.36	12.72	22,599	18.90	$40,325
	Conway, AR	21,164	82.36	11.85	0.64	0.16	0.00	0.00	1.41	3.58	17.64	8,137	21.90	$31,890
	Van Buren, AR	17,255	94.24	1.08	0.82	0.05	0.00	0.14	1.17	2.50	5.76	7,097	24.90	$32,906
	Cleburne, AR	25,788	95.70	0.42	0.48	0.00	0.03	0.00	1.40	1.95	4.30	10,678	16.60	$38,510
	Faulkner, AR	111,058	82.73	10.20	0.41	1.16	0.01	0.17	1.53	3.78	17.27	41,540	15.40	$47,649
	White, AR	76,041	89.81	4.00	0.22	0.31	0.02	0.03	1.98	3.63	10.19	29,529	16.40	$41,618
	Jackson, AR[1]	17,969	78.78	16.73	0.47	0.12	0.02	0.02	1.54	2.33	21.22	6,383	15.40	$31,352
	Region 5 Total	330,441	86.58	6.69	0.41	0.65	0.01	0.09	1.64	3.92	13.42	125,963	17.32	$38,510
6	Poinsett, AR[1]	24,622	89.04	6.86	0.22	0.09	0.11	0.02	1.45	2.21	10.96	9,427	26.00	$31,939
	Cross, AR	17,992	74.25	22.33	0.44	0.61	0.00	0.00	0.96	1.42	25.75	6,823	16.70	$38,432
	Region 6 Total	42,614	82.79	13.39	0.31	0.31	0.06	0.01	1.24	1.87	17.21	16,250	22.10	$35,186
7	Mississippi, AR	46,608	60.72	33.88	0.06	0.56	0.00	0.00	1.22	3.56	39.28	17,136	26.10	$34,267
	Shelby, TN	925,673	39.25	51.47	0.10	2.32	0.03	0.13	1.32	5.38	60.75	340,394	20.10	$46,102
	Tipton, TN	60,462	76.45	18.30	0.36	0.72	0.43	0.37	1.28	2.15	23.60	21,578	15.30	$50,869
	Region 7 Total	1,032,743	42.40	48.73	0.12	2.15	0.05	0.14	1.32	5.10	57.61	379,108	20.10	$46,102

1 Counties located in more than one region. These counties are assigned to one region for the purposes of analysis. Garfield and Muskogee counties, Oklahoma, and Pope County, Arkansas, are assigned to the region that includes the majority of the HVDC transmission line located in that county. The length of transmission line in Jackson and Poinsett counties, Arkansas, is fairly evenly divided between two regions. These counties are included in the first region from east to west. This distribution of counties by region is used throughout the following analysis.

Source: USCB (2011); GIS Data Source: USCB (2011).

3.5.5.7 Region 7

Region 7, located in the Arkansas Mississippi River Delta and Tennessee in Mississippi County in Arkansas, and Shelby and Tipton counties in Tennessee, includes Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. Figure 3.5-1f in Appendix A shows Census Block Groups containing low-income populations within Region 7.

3.5.5.8 Connected Actions

3.5.5.8.1 Wind Energy Generation

Table 3.5-12 presents data on Census Block Groups with identified minority populations within the WDZs. Table 3.5-13 presents data on Census Block Groups with identified low-income populations within the WDZs.

Table 3.5-12:
Race and Ethnicity Comparison for Census Block Groups within the WDZs

Census Block Group by County[1]	Total Population	Minority	WDZ
Beaver County	5,586	27.87%	J, K
Census Tract 9516, Block Group 3	680	49.26%	J
Texas County	33,964	41.86%	A, B, C, D, E, F, G, H, I, J
Census Tract 9507, Block Group 2	1,593	79.66%	D, E, F, J
Census Tract 9509, Block Group 1	1,566	88.51%	E
Census Tract 9509, Block Group 5	1,797	103.06%	E
Census Tract 9510, Block Group 2	845	92.19%	F
Hansford County	5,524	57.86%	A, B, C, L
Census Tract 9503, Block Group 1	1,063	69.33%	A, L
Census Tract 9503, Block Group 3	1,728	73.03%	L
Ochiltree County	10,147	71.38%	A, K, L
Census Tract 9503, Block Group 2	2,031	98.97%	A
Census Tract 9503, Block Group 3	879	93.97%	A
Census Tract 9504, Block Group 3	2,430	81.69%	A

1 Block Groups presented represent identified minority populations. For Wind Energy Generation, a population is defined as minority population if 50 percent or more of the population within the Block Group is minority or if the Block Group population has a "meaningfully greater" minority population compared to the whole county. Source: USCB (2011)

Table 3.5-13:
Poverty Status for Census Block Groups in the WDZs

Census Block Group by County1	Total Households	Percentage of People Below Poverty	WDZ
Texas County	7,122	14.4%	A, B, C, D, E, F, G, H, I, J
Census Tract 9506, Block Group 4	342	20.5%	I
Census Tract 9509, Block Group 1	630	22.2%	E
Census Tract 9509, Block Group 5	552	23.4%	E
Hansford County	1,895	13.2%	A, B, C, L
Census Tract 9503, Block Group 1	417	28.5%	A, L

Table 3.5-13:
Poverty Status for Census Block Groups in the WDZs

Census Block Group by County1	Total Households	Percentage of People Below Poverty	WDZ
Ochiltree County	3,735	16.9%	A, K, L
Census Tract 9503, Block Group 1	314	21.7%	A
Census Tract 9503, Block Group 2	679	29.9%	A

1 Block Groups presented represent identified low-income populations. Low-income populations are identified as low-income if 20 percent or more of the households within the Block Group live below the poverty level.
GIS Data Source: USCB (2011)

3.5.5.8.1.1 WDZ-A

WDZ-A contains a portion of 10 Census Block Groups in Hansford and Ochiltree counties, Texas. Of the 10 Census Block Groups in WDZ-A, two Census Block Groups were identified as having both minority and low-income populations (i.e., Census Block Group populations were greater than 50 percent minority and people living in poverty exceeded 20 percent), two Census Block Groups were identified as having only minority populations, and one Census Block Group was identified as having only low-income populations (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.2 WDZ-B

WDZ-B contains one Census Block Group in Hansford County, Texas. No potential minority or low-income populations were identified in the WDZ-B (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.3 WDZ-C

WDZ-C contains a portion of two Census Block Groups in Hansford and Sherman counties, Texas. No potential minority or low-income populations were identified in the WDZ-C (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.4 WDZ-D

WDZ-D contains one Census Block Group in Texas County, Oklahoma. One Census Block Group was identified as a a minority population within the Census Block Group exceeding 50 percent (Table 3.5-12). No low-income populations were identified in WDZ-D (Table 3.5-13).

3.5.5.8.1.5 WDZ-E

WDZ-E contains a portion of three Census Block Groups in Texas County, Oklahoma. Of the three Census Block Groups in the WDZ-E, two Census Block Groups were identified as having both minority and low-income populations (i.e., Census Block Group populations were greater than 50 percent minority and people living in poverty exceeded 20 percent), and one Census Block Group was identified as having only minority populations (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.6 WDZ-F

WDZ-F contains all or a portion of eight Census Block Groups in Hansford and Sherman counties, Texas. Of the eight Census Block Groups in WDZ-F, two Census Block Groups were identified as having minority populations (Table 3.5-12). No low-income populations were identified in WDZ-F (Table 3.5-13).

3.5.5.8.1.7 WDZ-G

The WDZ-G contains a portion of two Census Block Groups in Cimarron and Texas counties, Oklahoma. No minority or low-income populations were identified in the WDZ-G (Tables 3.5-12 and 3.5-13).

3.5.5.8.1.8 WDZ-H

The WDZ-H contains one Census Block Group in Texas County, Oklahoma. No minority or low-income populations were identified in WDZ-H.

3.5.5.8.1.9 WDZ-I

The WDZ-I contains all or a portion of five Census Block Groups in Texas County, Oklahoma. Of the five Census Block Groups in WDZ-I no minority populations were identified (Table 3.5-12). One Census Block Group was identified as a low-income population in WDZ-I (Table 3.5-13).

3.5.5.8.1.10 WDZ-J

WDZ-J contains all or a portion of three Census Block Groups in Beaver and Texas counties, Oklahoma. Of the three Census Block Groups in WDZ-J, two Census Block Groups were identified as having only minority populations (Table 3.5-12). No low-income populations were identified in WDZ-J (Table 3.5-13).

3.5.5.8.1.11 WDZ-K

WDZ-K contains a portion of three Census Block Groups in Beaver and Ochiltree counties, Texas. No minority or low-income populations were identified in WDZ-K.

3.5.5.8.1.12 WDZ-L

WDZ-L contains a portion of four Census Block Groups in Hansford and Ochiltree counties, Texas. Of the four Census Block Groups in the WDZ-L, one Census Block Group was identified as having both minority and low-income populations (i.e., Census Block Group populations were greater than 50 percent minority and people living in poverty exceeded 20 percent) and one Census Block Group was identified as having only minority populations (Tables 3.5-12 and 3.5-13).

3.5.5.8.2 Optima Substation

The ROI for the future Optima Substation includes Census Blocks and Census Block Groups in Texas County, Oklahoma. The affected environment for the future Optima Substation would be similar to the affected environment discussed in Section 3.5.4.2.

3.5.5.8.3 TVA Upgrades

As described in Section 3.1, a precise ROI has not been identified for the TVA upgrades. Identification of potential low-income and minority populations by county is not possible without more detailed information about the locations of the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.5.6 Environmental Justice Impacts

This section discusses potential impacts to minority or low-income populations from the construction and operation of the Project.

3.5.6.1 Methodology

Identifying whether disproportionately high and adverse human health or environmental effects on minority and/or low-income populations would occur typically involves identifying whether minority and/or low-income communities are present and whether the effects identified are predominantly borne by such populations. Minority populations and low-income populations are defined in Section 3.5.4.

Impacts can result if the proposed activities cause disproportionately high and adverse human health or environmental effects to minority and/or low-income populations. The environmental impacts from most projects tend to be highly concentrated at the actual project site and tend to decrease with distance from the project site. The environmental justice analysis for the Project examines Census Blocks and Census Block Groups in areas crossed by and in the immediate vicinity of the Project as described in Section 3.5.3. All resource areas analyzed in this EIS have been included in the environmental justice analysis. While impacts from the majority of the resource areas can be measured by proximity to the Project, special attention is given to the effects on human health in local communities. Disproportionately high and adverse human health effects are identified by assessing the following factors:

- Whether the health effects, which may be measured in risks or rates, are adverse and significant (as defined by NEPA) or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death.
- Whether the risk or rate of exposure to a minority or low-income population to an environmental hazard exceeds the risk or rate to the general population.
- Whether adverse health effects occur in a minority or low-income population because of multiple exposures to environmental hazards.

The Applicant would implement the EPMs listed in Appendix F as part of the Project to avoid or minimize potential impacts to environmental resources from construction, operations and maintenance, and/or decommissioning.

3.5.6.2 Impacts Associated with the Applicant Proposed Project

Impacts associated with the Applicant Proposed Project include those from construction, operations and maintenance, and decommissioning of the converter stations, AC transmission lines, and HVDC transmission lines and do not differ significantly. Based on the analysis of impacts for resource areas, few long-term significant impacts from construction, operation and maintenance, and decommissioning activities are expected.

Construction-related impacts could include removal of residential landscaping, power outages or damage to existing utility structures, potential groundwater contamination from excavation and handling of hazardous materials, increases in local traffic at some highway crossings and noise, and fugitive dusts. These impacts would be temporary and localized.

Long-term land use impacts could include the limitation on land use in the transmission line ROW and converter station footprint and loss of vegetation in the ROW during maintenance activities. Land use impacts are discussed in Section 3.10 and vegetation impacts are discussed in Section 3.17. Other long-term impacts could include groundwater contamination from inadvertent spills in the ROW and increased noise from helicopter inspections of the transmission lines and operation of converter stations and transmission lines. Groundwater impacts are discussed in Section 3.7 and noise impacts are discussed in Section 3.11.

Decommissioning-related impacts could include removal of residential landscaping, power outages or damage to existing utility structures, potential groundwater contamination from excavation and handling of hazardous materials, increases in local traffic at some highway crossings and noise, and fugitive dusts. These impacts would be temporary and localized, and are not expected to be high. Decommissioning would remove the long-term visual impacts related to the presence of transmission structures.

In areas where minority and/or low-income populations were identified, it is expected that any impacts would affect all populations in the ROI equally. No long-term significant impacts were discernable to agricultural resources; air quality and climate change; electrical environment; geology, paleontology, soils, and minerals; groundwater; health, safety, and intentional destructive acts; historic and cultural resources; land use; and noise. As shown in Section 3.8 there are no long-term impacts to any population.

3.5.6.2.1 Converter Stations and AC Interconnection Siting Areas

Section 3.5.4 presents the affected environmental justice characteristics for the Oklahoma and Tennessee converter stations and AC interconnection siting areas. No minority or low-income populations were identified in the Oklahoma Converter Station Siting Area. No minority populations were identified in the Tennessee Converter Station Siting Area. One Census Block Group in Shelby County contained low-income populations. Impacts from construction, operations and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

3.5.6.2.2 AC Collection System

Section 3.5.4 presents the affected environmental justice characteristics for the AC collection system. Table 3.5-14 lists the AC collection system routes, counties crossed, and counties where minority or low-income populations were identified. Impacts from construction, operation and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

Table 3.5-14:
AC Collection System Route Corridors and Counties where Minority or Low-Income Populations were Identified

AC Collection System Route	Counties Crossed	Counties where Minority or Low-income Populations were Identified
E-1	Oklahoma—Texas and Beaver	Oklahoma—Texas
E-2	Oklahoma—Texas and Beaver	Oklahoma—Texas
E-3	Oklahoma—Texas and Beaver	Oklahoma—Texas
NE-1	Oklahoma—Texas	Oklahoma—Texas
NE-2	Oklahoma—Texas	Oklahoma—Texas
NW-1	Oklahoma—Texas and Cimarron	Oklahoma—Texas

Table 3.5-14:
AC Collection System Route Corridors and Counties where Minority or Low-Income Populations were Identified

AC Collection System Route	Counties Crossed	Counties where Minority or Low-income Populations were Identified
NW-2	Oklahoma—Texas and Cimarron	Oklahoma—Texas
SE-1	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford and Ochiltree	Texas—Hansford and Ochiltree
SE-2	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford	Texas—Hansford
SE-3	Oklahoma—Texas	Oklahoma—Texas
	Texas—Ochiltree	Texas—Ochiltree
SW-1	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford	Texas—Hansford
SW-2	Oklahoma—Texas	Oklahoma—Texas
	Texas—Hansford and Sherman	Texas—Hansford
W-1	Oklahoma—Texas	Oklahoma—Texas

3.5.6.2.3 Applicant Proposed Route

Section 3.5.4 presents the affected environmental justice characteristics for the Applicant Proposed Route in Regions 1-7. Table 3.5-15 lists the HVDC applicant proposed route by region, counties crossed, and counties where minority or low-income populations were identified. Impacts from construction, operation and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

Table 3.5-15:
Applicant Proposed Route and Counties where Minority or Low-Income Populations were Identified

Region	Counties Crossed	Counties where Minority or Low-income Populations were Identified
Region 1	Oklahoma—Texas, Beaver, and Harper	Oklahoma—Texas County
Region 2	Oklahoma—Woodward, Major, and Garfield	Oklahoma—Woodward and Major
Region 3	Oklahoma—Garfield, Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, and Muskogee	Oklahoma—Okmulgee and Muskogee
Region 4	Oklahoma—Muskogee and Sequoyah	Oklahoma—Muskogee and Sequoyah
	Arkansas—Crawford, Franklin, Johnson, and Pope	Arkansas—Crawford, Franklin, Johnson, and Pope
Region 5	Arkansas—Pope, Conway, Van Buren, Cleburne, White, and Jackson	Arkansas—Pope, Conway, Van Buren, Cleburne, White, and Jackson
Region 6	Arkansas—Jackson, Cross, and Poinsett	Arkansas—Jackson, Cross, and Poinsett
Region 7	Arkansas—Poinsett and Mississippi	Arkansas—Poinsett and Mississippi
	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby

3.5.6.3 Impacts Associated with the DOE Alternatives

Impacts associated with the DOE Alternatives would be the same as those discussed in Section 3.5.6.2 for the Applicant Proposed Project.

3.5.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

Section 3.5.4 presents the affected environmental justice characteristics for the Arkansas converter stations and AC interconnection siting areas. Only one Census Block in Pope County had minority and low-income populations. Impacts from construction, operations and maintenance, and decommissioning activities would be the same as those discussed in Section 3.5.6.2.

3.5.6.3.2 HVDC Alternative Routes

Section 3.5.4 presents the affected environmental justice characteristics for the HVDC Alternative routes. Table 3.5-16 lists the counties crossed and the counties where minority or low-income populations were identified for the HVDC alternative routes. Impacts from construction, operation and maintenance, and decommissioning activities under all alternatives would be the same as those discussed in Section 3.5.6.2.

Table 3.5-16:
HVDC Alternative Routes and Counties where Minority or Low-Income Populations were Identified

HVDC Alternative Route	Counties Crossed	Counties where Minority or Low-income Populations were Identified
Region I		
1-A	Oklahoma—Texas, Beaver, Harper, and Woodward	Oklahoma—Texas and Woodward
1-B	Oklahoma—Texas and Beaver	Oklahoma—Texas
1-C	Oklahoma—Texas and Beaver	Oklahoma—Texas
1-D	Oklahoma—Beaver and Harper	None
Region 2		
2-A	Oklahoma—Woodward, Major, and Garfield	Oklahoma—Woodward and Major
2-B	Oklahoma—Major and Garfield	Oklahoma—Major
Region 3		
3-A	Oklahoma—Garfield, Logan, and Payne	None
3-B	Oklahoma—Garfield, Kingfisher, Logan, and Payne	None
3-C	Oklahoma—Payne, Lincoln, Creek, Okmulgee, and Muskogee	Oklahoma—Okmulgee and Muskogee
3-D	Oklahoma—Muskogee	Oklahoma—Muskogee
3-E	Oklahoma—Muskogee	Oklahoma—Muskogee
Region 4		
4-A	Oklahoma—Sequoyah	Oklahoma—Sequoyah
	Arkansas—Crawford and Franklin	Arkansas—Crawford and Franklin
4-B	Oklahoma—Sequoyah	Oklahoma—Sequoyah
	Arkansas—Crawford and Franklin	Arkansas—Crawford and Franklin
4-C	Arkansas—Crawford	Arkansas—Crawford
4-D	Arkansas—Crawford and Franklin	Arkansas—Crawford and Franklin
4-E	Arkansas—Franklin, Johnson, and Pope	Arkansas—Franklin, Johnson, and Pope
Region 5		
5-A	Arkansas—Pope	Arkansas—Pope
5-B	Arkansas—Pope, Conway, Faulkner, and White counties	Arkansas—Pope, Conway, and White
5-C	Arkansas—White	Arkansas—White
5-D	Arkansas—White and Jackson	Arkansas—White and Jackson

Table 3.5-16:
HVDC Alternative Routes and Counties where Minority or Low-Income Populations were Identified

HVDC Alternative Route	Counties Crossed	Counties where Minority or Low-income Populations were Identified
5-E	Arkansas—Van Buren, Faulkner, and White	Arkansas—Van Buren and White
5-F	Arkansas—Cleburne and White	Arkansas—Cleburne and White
Region 6		
6-A	Arkansas—Jackson and Poinsett	Arkansas—Jackson and Poinsett
6-B	Arkansas—Jackson and Poinsett	Arkansas—Jackson and Poinsett
6-C	Arkansas—Poinsett	Arkansas—Poinsett
6-D	Arkansas—Cross and Poinsett	Arkansas—Cross and Poinsett
Region 7		
7-A	Arkansas—Poinsett and Mississippi	Arkansas—Poinsett and Mississippi
	Tennessee—Tipton	Tennessee—Tipton
7-B	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby
7-C	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby
7-D	Tennessee—Tipton and Shelby	Tennessee—Tipton and Shelby

3.5.6.4 Communities of Shared Interest

The term ‘community of shared interest’ is used to refer to geographically dispersed individuals who could experience common conditions of environmental impacts. The National Agricultural Workers Survey for fiscal years 2001 and 2002 found that 83 percent of crop workers in the United States identified themselves as members of a Hispanic group and that 78 percent of crop workers were born outside the United States, primarily in Mexico (75 percent of all crop workers) (DOL 2005). This survey also found that 30 percent of all farm workers had total family incomes below federal poverty guidelines.

The potential effects of construction on agriculture production are addressed in Section 3.2, and the potential effects to the agricultural sector and employment are discussed in Section 3.13. Operation of the Project has the potential to disproportionately affect minority and low-income farm workers. Viewed in terms of agricultural operations in the potentially affected counties, however, total estimated construction disturbance represents a very small percentage and is not likely to noticeably impact agricultural production or employment or cause adverse impacts to human health or the environment.

3.5.6.5 Best Management Practices

No BMPs have been identified. The Applicant would implement the EPMs listed in Appendix F to avoid or minimize potential impacts to environmental resources from construction, operations and maintenance, and/or decommissioning of the Project.

3.5.6.6 Unavoidable Adverse Impacts

No unavoidable adverse impacts were identified.

3.5.6.7 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of resources was identified.

3.5.6.8 Relationship between Local Short-term Uses and Long-term Productivity

Because the EIS did not identify any disproportionately high and adverse impacts to low-income or minority populations, there would be no long-term impact to these populations.

3.5.6.9 Impacts from Connected Actions

3.5.6.9.1 Wind Energy Generation

Section 3.5.3.3.1 presents the affected environmental justice characteristics for wind energy generation. Environmental justice areas were identified in 7 of the 12 WDZs. Tables 3.5-12 and 3.5-13 lists Census Block Groups where minority or low-income populations were identified within WDZs.

Based on the analysis of impacts for resource areas, few long term impacts from construction and operations and maintenance activities are expected.

Impacts related to the construction of wind farms would be short term and could include noise impacts from machinery and blasting, increased levels of fugitive dust and increases in local traffic. Impacts related to operations and maintenance could include visual, noise, or shadow flicker.

In areas where minority and/or low-income populations were identified, it is expected that any impacts would affect all populations in the ROI equally. No high or adverse impacts were discernible to agricultural resources; air quality and climate change; electrical environment; geology, paleontology, soils, and minerals; groundwater; health, safety, and intentional destructive acts; historic and cultural resources; land use; and noise. As shown in Section 3.8, there are no long term impacts to any population.

3.5.6.9.2 Optima Substation

Section 3.5.5.8.2 presents the affected environmental justice characteristics for the future Optima Substation. The future Optima Substation is anticipated to be located within the Oklahoma AC Interconnection Siting Area in Texas County, Oklahoma. Impacts associated with the future Optima Substation would be the same as those discussed in Section 3.5.6.2 for the Applicant Proposed Project.

3.5.6.9.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

Identification of potential low-income and minority populations by county would require more detailed information about the potential locations of the TVA upgrades. Some of the affected counties may have qualifying minority and low-income populations that could raise environmental justice concerns. Depending on location, construction of the new electric transmission line that would be required may have greater potential to affect qualifying minority and low-income populations than required upgrades to existing facilities.

3.5.6.10 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not move forward, so no disproportionately high and adverse effects to low-income and minority populations would result from activities related to construction, operations and maintenance, or decommissioning.

Contents

Tables

Figures Presented in Appendix A

3.6 Geology, Paleontology, Minerals, and Soils

This section is divided under two major headings: geology, paleontology, and mineral resources (section 3.6.1) and soils (section 3.6.2). The reason for the separation is that the affected environment and impacts associated with soils—such as farmland, erosion, and compaction—are generally much different than those for geology (e.g. geologic hazards such as earthquakes and karst).

3.6.1 Geology, Paleontology, and Minerals

3.6.1.1 Regulatory Background

One federal law related to geology, paleontology, minerals, or soils that could affect the proposed Project or the manner in which it would be implemented is listed in (Table 3.6.1-1). No applicable state or local quantitative geological or soil regulations exist for the states of Oklahoma, Arkansas, Tennessee, or Texas. Seismic activity prone areas, such as Shelby County, Tennessee, are in the process of evaluating the adoption of the 2009 National Earthquake Hazards Reduction Program Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA 2009) or other applicable regulations.

Table 3.6.1-1:
Federal Law Associated with Geological Resources

Statute/Regulation	Key Elements
National Earthquake Hazards Reduction Program Reauthorization Act of 2004 (42 USC 7701 *et seq.*)	The purpose of the National Earthquake Hazards Reduction Program Reauthorization Act of 2004 (42 USC 7701 et seq.) is to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program. The Act supports the development of standards and technology for buildings and structures to withstand damage from earthquakes.

3.6.1.2 Data Sources

Data sources include published maps and reports and internet websites of the U.S. Geological Survey (USGS), Oklahoma Geological Survey, Arkansas Geological Survey, and Federal Emergency Management Agency (FEMA). Digital information on faults, earthquakes, landslides, karst features, soil liquefaction, and seismicity was obtained from USGS datasets and maps (GIS Data Sources: EIA 2011a, 2011b; Tobin and Weary 2004, USGS 2005a, 2005b, 2008a, 2008b, 2014, 2010; CUSEC 2008; NRCS 2006, 2013; EPA 2014b; Garrity and Soller 2009). Other data sources included academic and professional journals and publications. Reference citations are provided within the text and a complete listing of each reference is provided in Chapter 6. A summary description of the reference sources follows:

- The probabilistic seismic hazard analyses incorporate estimates of the magnitude and location of all likely earthquakes, how often these earthquakes would occur, and the strength of ground shaking they would cause (USGS 2010a, 2010b; USGS and TBEG 2006).
- Karst areas were identified based on information from USGS.
- FEMA Hazus Program Liquefaction Susceptibility Maps (GIS Data Source: CUSEC 2008) were used to determine liquefaction susceptibility.
- USGS-prepared Landslide Inventory Maps (GIS Data Source: USGS 2001) were used to evaluate geologic formations or groups of formations as having high, moderate, or low landslide susceptibility.

- The potential for impacts to mineral resource accessibility and fossil resources was determined as follows. Mineral resources were mapped to determine whether the Project might impact accessibility to existing and potential extraction operations. The primary mineral resources produced in the region are fossil fuels including oil, natural gas, and coal. Additional minerals mined in the region include limestone, building stone, sand and gravel, gypsum, clay and shale, granite, volcanic ash, Tripoli, salt, bentonite, iron ore, and chat.
- The BLM and local natural history museums (Clean Line 2014) were contacted regarding potential significant fossil finds/beds.

3.6.1.3 Region of Influence

3.6.1.3.1 Region of Influence for the Project

The ROI for paleontology resources is the same as the description provided in Section 3.1.1.

Specific to geologic and mineral resources, the ROI was increased, and the following areas for Project components were evaluated to provide an indication of surrounding mineral resource operations to evaluate potential impacts related to the potential future expansion of mineral mines and oil and gas drilling operations that might encroach on the Project:

- Oil and gas wells and mines: a 4,000-foot-wide corridor along the HVDC transmission lines
- Oil and gas wells and mines: a 1,500-foot-wide buffer surrounding the converter station siting areas

3.6.1.3.2 Region of Influence for Connected Actions

The geology, minerals, and paleontology ROI for wind energy generation, the future Optima substation, and the TVA upgrades is described in Section 3.1.1.

3.6.1.4 Affected Environment

3.6.1.4.1 Physiography and Surface Geology

The Project traverses three physiographic divisions: the Interior Plains, Ouachita-Ozark Highlands, and the Atlantic Plain (GIS Data Source: NRCS 2006). The Interior Plains Division encompasses the Oklahoma converter station and AC interconnection in Region 1; the HVDC transmission line in Regions 1, 2, and part of 3; and the AC collection system in Region 1.

The Interior Plains Division is characterized by thick layers of sediments that accumulated in shallow seas that once covered large areas of North America. These sediments were buried and lithified (transformed into stone) into marine shales, limestones, and sandstones. They were subsequently uplifted, and rocks and sediments that were deposited earlier were exposed and eroded. Uplift processes include the gentle arching of broad areas, and mountain building, whereby rocks were intensely folded, faulted, and thrust upward. The majority of the region has low relief, reflecting more than 500 million years of relative tectonic stability, and is drained by tributaries of either the Mississippi or Missouri River system (Fenneman 1928).

The Arkansas converter station and AC interconnection, and the HVDC transmission line in the remainder of Region 3, Region 4, and the majority of Region 5, are within the Ouachita-Ozark Highlands Division, which includes the Osage Cuestas Lower Boston Mountains, Lower Boston Mountains, and Arkansas Valley Hills. The Oucahita-Ozark Highlands Division contains ancient eroded mountains surrounded by nearly flat-lying sedimentary rocks and deposits of the Interior and Atlantic Plains divisions. Unlike the relatively young rocks that characterize neighboring physiographic provinces, the rocky outcrops that make up the core of the Ouachita-Ozark Highlands consist of Paleozoic-age carbonate and other marine sedimentary rocks (Foti and Bukenhofer 1998).

The Tennessee converter station and AC interconnection and the HVDC transmission line in Regions 5, 6, and the western portion of Region 7 are within the Atlantic Plain Division. The Atlantic Plain Division consists of an intra-continental rift zone, centered under the New Madrid Fault, covered by thick layers of sedimentary and volcanic debris thousands of feet thick (Foti and Bukenhofer 1998). The Atlantic Plain Division slopes gently seaward from the Inland Highlands in a series of terraces, continuing far into the Atlantic and Gulf of Mexico, where it forms the continental shelf. The Atlantic Plain Division is the flattest physiographic region traversed by the Project.

3.6.1.4.2 Bedrock Geology and Paleontological Resources

This section discusses the bedrock geology and paleontological resources throughout the ROI and focuses primarily on the upper strata of bedrock and fossils formed during the Quaternary Period, the most recent geological period in Earth’s history, which is divided into the Pleistocene and Holocene epochs.

Oklahoma and Texas

The Oklahoma converter station and AC interconnection; the AC collection system routes; and the HVDC transmission line in Regions 1, 2, 3, and the western part of Region 4 are located in Oklahoma and Texas and have similar geology (GIS Data Source: Garrity and Soller 2009).

Clay, silt, sand, and gravel from Pleistocene and Holocene deposits are typically unconsolidated and range in depth from 25 to 100 feet thick. Modern floodplains consist mainly of alluvium deposited during the Holocene Epoch. Quaternary river-borne sediments decrease in grain size from west to east across Oklahoma; gravel, commonly mixed with river sands in the west, is abraded so much during transport that it is almost absent in the east. Eolian (wind carried) sediments characterize Quaternary deposits in sand dunes in western Oklahoma and occur primarily on the northern sides of major rivers (Johnson 2008).

The Anadarko Shelf and northern portion of the Anadarko Basin underlie the AC collection system routes and HVDC transmission line in Regions 1 and 2. The Cherokee Platform underlies the HVDC transmission line that traverses Region 3. The western portion of the Anadarko Basin consists of Tertiary river and windblown deposits of sand, clay, gravel, and caliche deposited from ancient rivers draining the Rocky Mountains, generally 200 to 600 feet thick. The eastern portion of the Anadarko Basin and the western Cherokee Platform consists of Permian, shallow-marine, deltaic, and alluvial deposits of predominately red sandstone and shale, with conspicuous outcrops of white gypsum and thick salt deposits in the subsurface of the Anadarko, generally 1,000 to 6,500 feet thick (Johnson 2008).

The upper portion of the eastern Anadarko Basin and the lower portion of the western Cherokee Platform consist of marine red sandstone and shale with some thin beds of limestone. The eastern Cherokee Platform consists of Pennsylvanian marine shale, with interbedded sandstone, limestone, and coal, commonly 2,000 to 5,000 feet thick. The Ozark Uplift underlies western portion of the HVDC transmission line traverse in Region 4. The Uplift is typified by mostly marine Mississippian shale and sandstone commonly 1,000 to 6,000 feet thick, but up to 10,000 feet thick in the Ouachita Mountains, as well as Silurian-Devonian marine chert, shale, and sandstone in 500- to 1,500-foot-thick units (Johnson 2008). Shale plays (defined geographic areas containing an organic-rich, fine-grained sedimentary rock with unique characteristics) in the ROI are shown on Figure 3.6-1 (located in Appendix A).

Arkansas and Tennessee

The state of Arkansas is broken into different geological regions, two of which are traversed by the ROI: the Ozark Plateaus and the Mississippi Embayment and Gulf Coastal Plain (GIS Data Source: EPA 2010). The eastern portion of the HVDC transmission line in Region 4, the western section of Region 5, and the Arkansas converter station occur within the Ozark Plateau. This area is generally flat-lying Paleozoic-age strata divided into three plateau surfaces. The plateau that the ROI traverses is the Boston Mountains, the southernmost and highest plateau in the Ozark Region. Pennsylvanian age shales, siltstones, and sandstones dominate the bedrock (McFarland 1998).

The Tennessee converter station and AC interconnection, the HVDC transmission line in eastern part of Region 5 and in Regions 6 and 7, and the Tennessee Converter Station Siting Area are in the Mississippi Embayment and Gulf Coastal Plain. The Mississippi River Alluvial Plain (within the Mississippi Embayment) consists of recent sedimentary deposits with small areas of igneous intrusions. Cretaceous sedimentary deposits are exposed in southwestern Arkansas and represent shallow, marginal, and often restricted marine environments. This region's upper strata are dominated by Quaternary terrace and alluvial deposits (McFarland 1998).

3.6.1.4.3 Geologic Hazards

3.6.1.4.3.1 Seismic Hazards

Seismicity refers to the intensity and the geographic and historical distribution of earthquakes (USGS 2013; GIS Data Source: USGS 2008a). This analysis includes earthquakes of magnitude (M) 3.5 or greater that have occurred within 50 miles of the ROI over the last 150 years (USGS 2013; GIS Data Source: USGS 2008a). Earthquake damage is a function of magnitude and proximity to vulnerable structures/features. While earthquakes of M3.5 to M4.0 may not be noticed by most people, they can cause minor damage (e.g., cracks in mortar or stone cladding) to structures within a few miles. Earthquakes of M4.0 to M4.9 are typically felt and can cause slight damage, overturn unstable objects, and trigger landslides on extremely unstable slopes. Earthquakes of M5.0 to M5.9 will cause slight to moderate damage in well-built ordinary structures and considerable damage in poorly built or badly designed structures (USGS 2013).

Recently, an increase in seismic events within 50 miles of the ROI has occurred (more than 250 since 2005, with approximately 100 greater than M3.5, compared to 67 between 1980 and 2005 and 33 between 1863 and 1980). Most are low intensity (less than M4.0) and located around the Woodford shale in Oklahoma and Fayetteville shale in Arkansas. Recent USGS research (USGS 2014) has confirmed that the increased frequency of these seismic events may be at least partially caused by hydraulic fracturing (the fracturing of rock by a pressurized liquid) and enhanced recovery operations in some areas.

The probabilistic seismic hazard analyses data used to assess the ROI incorporate estimates of the magnitude and location of all likely earthquakes, how often these earthquakes occur, and the strength of ground shaking that they cause. The data are time independent, represent a long-term average hazard, and are not affected by when the last earthquake rupture occurred (USGS 2010a, 2010b, USGS and TBEG 2010). The USGS Seismic Hazard Mapping Program (GIS Data Source: USGS 2008a) expresses the probabilistic seismic hazard analyses for the peak ground acceleration (PGA) as a factor of gravity (g), with a 10 percent probability of exceedance within a 50-year period. PGA is defined as a measure of earthquake acceleration on the ground. It is not a measure of the total energy (magnitude or size) of the earthquake, but rather of how hard the earth shakes in a given geographic area (the intensity). In this analysis, PGA is expressed in g (the acceleration due to Earth's gravity, equivalent to g-force).

3.6.1.4.3.2 Landslides

The primary cause of landslides is gravity acting on an over-steepened slope. Other contributing factors include intense or prolonged rainfall, earthquakes, rapidly melting snow, volcanic activity, and various human actions. USGS prepared Landslide Inventory Maps (GIS Data Source: USGS 2001) that DOE used to evaluate the ROI by evaluating geologic formations or groups of formations as having high, medium, or low landslide susceptibility.

Landslide incidence is defined as the number of landslides that have occurred in a given geographic area. Landslide susceptibility is defined as the probable degree of slope failure. The landslide susceptibility/incidence map for the ROI is shown in Figure 3.6-3 in Appendix A. The map units are divided into three incidence categories according to the percentage of the area affected by landslides:

- Low (less than 1.5 percent of area has experienced landslides)
- Moderate (1.5 percent to 15 percent area has experienced landslides)
- High (greater than 15 percent of area has experienced landslides)

Low, moderate, and high susceptibility are delimited by the same percentages as those used to define the incidence categories. Susceptibility is not indicated where it is the same as or lower than incidence. The map units are divided into three additional incidence/susceptibility categories:

- Moderate susceptibility/low incidence
- High susceptibility/low incidence
- High susceptibility/moderate incidence

3.6.1.4.3.3 Subsidence

Subsidence hazards involve either the sudden collapse of the ground to form a depression or the slow movement downward or compaction of the sediments near the earth's surface. The most common types of subsidence are subsidence due to erosion of soil or rock and collapses involving the dissolution of carbonate rocks (limestones) beneath the surface. Subsidence in the ROI can occur in areas of karst geologic formations, or elsewhere, as result of drainage of wet soils.

The presence of karst formations can contribute to land subsidence. Karst is distinctive topography in which the landscape is largely shaped by the dissolving action of water on carbonate and evaporative rock (usually limestone, dolomite, or marble). Karst terrain is characterized by disappearing streams, springs, caves, and sinkholes (Epstein et al 2005). Karst areas were identified for the ROI based on information from USGS (GIS Data Source: Tobin and Weary 2004). Karst areas for the ROI are shown on Figure 3.6-4 in Appendix A.

3.6.1.4.3.4 Soil Liquefaction

Liquefaction may occur when loose, cohesionless, and water-saturated soils lose strength and stiffness in response to stress, such as the ground shaking from an earthquake, causing the soil to behave like a liquid (NRCS 2014). Liquefaction potential in a soil layer increases with decreasing fines content and plasticity of the soil. Liquefaction is more likely to occur in soil/sediment layers with at least 80 to 85 percent saturation and located within 50 feet of the ground surface.

State geologists for Arkansas, Tennessee, and the six other states surrounding the New Madrid Seismic Zone developed Liquefaction Susceptibility Maps for the FEMA Hazus program (GIS Data Source: CUSEC 2008). The maps include six categories for Liquefaction Susceptibility: None, Very Low, Low, Moderate, High, and Very High. Data are not available for portions of the ROI located in Oklahoma and Texas. However, soil liquefaction is less likely in these states because of lower probable PGA. Liquefaction susceptibility for the ROI is shown in Figure 3.6-5 (located in Appendix A).

3.6.1.4.3.5 Paleontological Resources

Fossils would be more likely encountered in areas of shallow bedrock. Quaternary rocks may contain fossils of wood, clams, snails, horses, camels, bison, and mammoths. Tertiary rocks may contain abundant fossils of mammals, including the remains of horses, camels, mastodons, and rhinoceroses. Petrified wood can also be found in these rocks. Lake sediments can contain fossil snails, clams, and algae. Cretaceous, Jurassic, and Triassic rocks may contain abundant fossils, including large oysters, echinoids (sea biscuits), clams, and snails, as well as shark teeth and the occasional remains of large reptiles, such as crocodiles, mosasaurs, and plesiosaurs. Permian rocks may contain fossils of amphibians and reptiles as well as vertebrate footprints.

3.6.1.4.3.6 Mineral Resources

In the ROI, the primary mineral resource production is from fossil fuels, oil, natural gas, and coal. Additional minerals mined include limestone, building stone, sand and gravel, gypsum, clay and shale, granite, volcanic ash, Tripoli, salt, bentonite, iron ore, and chat. Portions of the Project traverse significant oil and natural gas fields, particularly the Anadarko Basin and Arkoma Basin (GIS Data Source: USGS 2005b).

The western portion of the ROI (particularly in Regions 4 and 5) is located within a part of the United States that is experiencing a boom in natural gas production because of the use of hydraulic fracturing and horizontal drilling technologies. This new technology has made the recovery of shale gas economically viable. Mineral resources within the ROI are shown on Figure 3.6-6 (located in Appendix A).

3.6.1.5 Regional Description

3.6.1.5.1 Region 1

Geologic hazards and mineral resources within the ROI in Region 1 for the HVDC alternative routes and AC collection system route alternatives are summarized in Table 3.6.1-2. Tables throughout the regional description sections that follow show only the information that is relevant for each. For example, because landslide potential is low, and no seismic fault lines, mines, or shale gas plays are located in Region 1, these are not shown in the table. Soil liquefaction is unlikely in the ROI because of the low probable PGA.

Table 3.6.1-2:
Geologic Hazards and Mineral Resources—Region 1

Hazard/Mineral Resource	HVDC Alternative Routes				APR Total	Oklahoma Converter Station
	AR 1-A	AR 1-B	AR 1-C	AR 1-D		
Geologic Hazard						
3.5–3.9 Earthquakes (number)[1]	1	1	1	1	1	0
4.0+ Earthquakes (number)[1]	2	1	1	1	2	1

Table 3.6.1-2:
Geologic Hazards and Mineral Resources—Region 1

Hazard/Mineral Resource	HVDC Alternative Routes				APR Total	Oklahoma Converter Station
	AR 1-A	AR 1-B	AR 1-C	AR 1-D		
Karst Formation (acres and percentage of entire ROI)[2]	1,215 (8%)	2,202 (35%)	1,203 (19%)	0 (0%)	3,474 (25%)	626 (100%)
Shallow Bedrock (acres and percentage of entire ROI)[3]	2,852 (19%)	515 (8%)	341 (5%)	225 (5%)	1,681 (12%)	264 (42%)
Mineral Resources						
Oil and Gas Wells[4]	19	11	8	5	33	0
Mineral Resources[5]	3	6	2	1	9	0

Hazard/Mineral Resource	AC Collection System Routes												
	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Geologic Hazard													
3.5 - 3.9 Earthquakes[1] (number)	0	0	0	0	0	0	0	1	0	1	0	2	0
4.0 + Earthquakes[1] (number)	1	1	1	1	1	1	1	1	1	1	1	1	1

Hazard/Mineral Resource	AC Collection System Routes												
	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Karst Formation (acres and percentage of entire ROI) [2]	11,404 (29%)	37,409 (71%)	30,576 (57%)	25,271 (63%)	17,079 (49%)	28,979 (43%)	61,241 (83%)	33,789 (64%)	18,926 (100%)	48,940 (76%)	19,142 (100%)	13,176 (27%)	7,686 (27%)
Shallow Bedrock (acres and percentage of entire ROI)[3]	7,015 (18%)	3,713 (7%)	6,176 (12%)	3,517 (9%)	5,326 (15%)	4,240 (6%)	3,950 (5%)	4,270 (8%)	1,927 (10%)	3,825 (6%)	1,986 (10%)	5,787 (12%)	2,522 (9%)
Mineral Resources													
Oil and Gas Wells[4]	12	19	15	0	0	4	0	0	0	43	0	0	0
Mineral Resources[5]	4	8	8	8	7	9	7	5	1	7	1	3	6

GIS Data Sources:
1 USGS (2008a)
2 Tobin and Weary (2004)
3 NRCS (2013)
4 OCC (2013)
5 USGS (2005b)

No known fossil bed sites were identified in the ROI in Region 1. Fossils would be more likely encountered in areas of shallow bedrock, which underlies 12 percent of the Applicant Proposed Route and 5 to 19 percent of the HVDC alternative routes. Shallow bedrock underlies 5 to 18 percent of the AC collection system routes.

3.6.1.5.2 Region 2

Geologic hazards and mineral resources within the ROI in Region 2 are summarized in Table 3.6.1-3. Soil liquefaction is unlikely in the ROI because of the low probable PGA.

Table 3.6.1-3:
Geologic Hazards and Mineral Resources within the ROI—Region 2

Hazard/Mineral Resource	HVDC Alternative Route		APR Total
	AR 2-A	AR 2-B	
Geologic Hazards			
3.5–3.9 Earthquakes(number)[1]	6	27	28
4.0+ Earthquakes (number)[1]	1	4	5
Karst Formation (acres and percentage of entire ROI)[2]	1,531 (22%)	0 (0%)	941 (7%)
Shallow Bedrock (acres and percentage of entire ROI)[3]	2,703 (39%)	1,504 (41%)	2,336 (18%)
Mineral Resources			
Oil and Gas Wells[4]	0	3	5
Mineral Resources[5]	0	0	1
Shale Gas Plays (acres and percentage of entire ROI)[6]	0 (0%)	0 (0%)	2,609 (20%)

GIS Data Sources:
1 USGS (2008a)
2 Tobin and Weary (2004)
3 NRCS 2013
4 OCC 2013
5 USGS 2005b
6 EIA (2011a)

No known fossil bed sites were identified in the ROI in Region 2. Fossils would be more likely encountered in areas of shallow bedrock, which occur in isolated areas in 18 percent of the Applicant Proposed Route and in all segments of the HVDC alternative route ROIs (39 to 41 percent).

3.6.1.5.3 Region 3

Geologic hazards and mineral resources within Region 3 are summarized in Table 3.6.1-4. The ROI in Region 3 has a higher number of recorded seismic events than other regions, particularly where it crosses the Nemaha uplift and energy productions areas of the Woodford shale. Soil liquefaction is unlikely in the ROI because of the low probable PGA. Three percent of the ROI for the Applicant Proposed Route is within an area of high susceptibility to landslides. HVDC Alternative Routes AR 3-C and AR 3-D also include areas of high susceptibility to landslides.

Table 3.6.1-4:
Geologic Hazards and Mineral Resources within the ROI—Region 3

Hazard/Mineral Resource	HVDC Alternative Route					APR Total
	AR 3-A	AR 3-B	AR 3-C	AR 3-D	AR 3-E	
Geologic Hazards						
3.5–3.9 Earthquakes (number)[1]	44	45	43	3	0	47
4.0+ Earthquakes (number)[1]	9	9	9	0	0	9
Seismic Fault Lines (number)[2]	0	0	0	0	0	1
High Susceptibility to Landslides and Low Incidence (acres and percentage of ROI)[3]	0 (0%)	0 (0%)	605 (41%)	605 (13%)	0 (0%)	611 (3%)
Shallow Bedrock (acres and percentage of ROI)[4]	3,426 (74%)	4,264 (73%)	7,435 (50%)	1,615 (34%)	580 (54%)	11,092 (56%)
Mineral Resources						
Mineral Resources[5]	0	0	2	0	0	10

GIS Data Sources:
1 USGS (2008a)
2 USGS (2005a)
3 USGS (2001)
4 NRCS 2013
5 USGS 2005b

No known fossil bed sites were identified in ROI in Region 3. Occurrences of shallow bedrock occur in all segments of the Applicant Proposed Route and HVDC alternative routes.

The Ripley Quarry, a crushed stone quarry, is located within the Region 3 ROI. Based on aerial reconnaissance (Clean Line 2013), the quarry does not currently appear to be active. The Applicant Proposed Route and HVDC alternative routes intersect up to 10 mineral resource locations.

3.6.1.5.4 Region 4

Geologic hazards and mineral resources within the ROI in Region 4 are summarized in Table 3.6.1-5. Although the ROI in Region 4 is an area of low earthquake activity, four active surface faults are located within the ROI. Approximately 20 percent of the soils within the ROI in Arkansas have high liquefaction susceptibility, but none have very high liquefaction susceptibility. As previously discussed, soil liquefaction data are not available for Oklahoma.

Table 3.6.1-5:
Geologic Hazards and Mineral Resources within the ROI—Region 4

Hazard/Mineral Resource	HVDC Alternative Routes					APR Total
	AR 4-A	AR 4-B	AR 4-C	AR 4-D	AR 4-E	
Geologic Hazards						
3.5–3.9 Earthquakes (number)[1]	0	1	0	0	16	16
4.0+ Earthquakes (number)[1]	0	0	0	0	3	3
Seismic Fault Lines (number)[2]	2	2	0	1	0	4
Karst Formation (acres and percentage of ROI)[3]	4,251 (59%)	5,233 (54%)	425 (100%)	2,753 (89%)	0 (0%)	3,356 (22%)
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[4]	0 (0%)	0 (0%)	160 (38%)	28 (1%)	475 (11%)	2,151 (14%)

Table 3.6.1-5:
Geologic Hazards and Mineral Resources within the ROI—Region 4

Hazard/Mineral Resource	HVDC Alternative Routes					APR Total
	AR 4-A	AR 4-B	AR 4-C	AR 4-D	AR 4-E	
Shallow Bedrock (acres and percentage of ROI)[5]	6,080 (85%)	7,706 (80%)	425 (100%)	2,711 (87%)	2,646 (59%)	9,679 (63%)
Mineral Resources						
Oil and Gas Wells[6]	18	48	4	12	76	181
Mineral Resources[7]	1	1	0	0	2	3
Shale Gas Plays (acres and percentage of ROI)[8]	2,870 (40%)	4,743 (49%)	425 (100%)	3,106 (100%)	4,491 (100%)	9,618 (62%)

GIS Data Sources:
1 USGS (2008a)
2 USGS (2005a)
3 Tobin and Weary (2004), USFWS (2010)
4 CUSEC (2008)
5 NRCS 2013
6 OCC 2013 and AOGC 2014
7 USGS 2005b
8 EIA (2011a)

No known fossil bed sites were identified in the ROI in Region 4, but fossils would be more likely encountered in areas of shallow bedrock. Intersected shale gas plays and oil and gas wells are primarily located in the eastern part of Region 4.

3.6.1.5.5 Region 5

Geologic hazards and mineral resources within Region 5 are summarized in Table 3.6.1-6. The ROI in Region 5 is an area of low to moderate earthquake activity with seven active surface faults. An unclassified fault crosses the south quarter of the Arkansas converter station alternative (GIS Data Source: Garrity and Soller 2009). Earthquake hazard transitions from low to moderate with eastward progression within the Region 5 ROI. Soils with high liquefaction susceptibility are mostly located in the easternmost portion of the ROI. Approximately 22 percent of the soils within the siting area for the Arkansas Converter Station Alternative have high liquefaction potential, but there are no soils with a very high liquefaction potential.

Table 3.6.1-6:
Geologic Hazards and Mineral within the ROI—Region 5

Hazard/Mineral Resource	HVDC Alternative Route						APR Total	Arkansas Converter Station
	AR 5-A	AR 5-B	AR 5-C	AR 5-D	AR 5-E	AR 5-F		
Geologic Hazards								
3.5–3.9 Earthquakes (number)[1]	23	23	21	27	22	22	29	23
4.0+ Earthquakes (number)[1]	9	9	9	11	9	9	11	9
Seismic Fault Lines (number)[2]	0	1	0	1	1	0	2	1
High Susceptibility to Landslides and Low Incidence (acres and percentage of ROI)[3]	0 (0%)	0 (0%)	0 (0%)	761 (29%)	0 (0%)	0 (0%)	559 (49%)	0 (0%)

Table 3.6.1-6:
Geologic Hazards and Mineral within the ROI—Region 5

Hazard/Mineral Resource	HVDC Alternative Route						APR Total	Arkansas Converter Station
	AR 5-A	AR 5-B	AR 5-C	AR 5-D	AR 5-E	AR 5-F		
Karst Formation (acres and percentage of ROI)[4]	0 (0%)	0 (0%)	0 (0%)	1,930 (73%)	0 (0%)	0 (0%)	1,535 (11%)	0 (0%)
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[5]	0 (0%)	305 (4%)	0 (0%)	862 (32%)	0 (0%)	0 (0%)	1,316 (10%)	4,873 (22%)
Shallow Bedrock (acres and percentage of ROI)[6]	1,289 (83%)	7,985 (92%)	1,032 (91%)	2,085 (78%)	4,197 (94%)	2,516 (92%)	11,962 (87%)	17,837 (82%)
Mineral Resources								
Oil and Gas Wells[7]	14	212	65	5	103	57	282	42
Mineral Resources[8]	0	4	0	0	2	2	0	1
Shale Gas Plays (acres and percentage of ROI)[9]	1,553 (100%)	8,686 (100%)	1,137 (100%)	2,547 (96%)	4,449 (100%)	2,748 (100%)	13,128 (95%)	21,862 (100%)

GIS Data Sources:
1 USGS (2008a)
2 USGS (2005a)
3 USGS (2001)
4 Tobin and Weary (2004), USFWS (2010)
5 CUSEC (2008)
6 NRCS (2013)
7 AOGC (2014)
8 USGS (2005b)
9 EIA (2011a)

Forty-nine percent of the Applicant Proposed Route ROI is within an area of high susceptibility to landslides. The Arkansas Converter Station Siting Area is characterized by moderate susceptibility to landsliding and low incidence.

Eleven percent of Applicant Proposed Route ROI and 73 percent of HVDC Alternative Route 5-D ROI is located within karst formations. No karst formations have been identified for the remainder of the HVDC Alternative Route ROIs in Region 5 or in the Arkansas Converter Station Alternative Siting Area, so the susceptibility for land subsidence as a result of karst formations is low.

No known fossil bed sites were identified in the ROI in Region 5. Fossils would be more likely encountered in areas of shallow bedrock.

3.6.1.5.6 Region 6

Geologic hazards and mineral resources within Region 6 are summarized in Table 3.6.1-7. The earthquake hazard transitions from low to moderate to moderate to high with eastward progression along the ROI in Region 6. The easternmost portion of the Applicant Proposed Route ROI and HVDC Alternative Routes 6-C and 6-D are located within moderate to high seismic hazard areas and are closer to the New Madrid Seismic Zone. Ninety-four percent of the soils have high to very high liquefaction susceptibility in the Region 6 ROI.

Table 3.6.1-7:
Geologic Hazards and Mineral Resources within the ROI—Region 6

Hazard/Mineral Resource	HVDC Alternative Routes				APR Total
	AR 6-A	AR 6-B	AR 6-C	AR 6-D	
Geologic Hazards					
3.5–3.9 Earthquakes (number)[1]	6	6	10	9	11
4.0+ Earthquakes (number)[1]	3	3	6	6	6
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[2]	1,982 (100%)	1,724 (100%)	2,550 (89%)	1,134 (100%)	6,233 (94%)
Shallow Bedrock (acres and percentage of ROI)[3]	1,180 (60%)	983 (57%)	1,329 (47%)	15 (1%)	3,095 (47%)

GIS Data Sources:
1 USGS (2008a)
2 CUSEC (2008)
3 NRCS (2013)

No known fossil bed sites were identified in the Cretaceous-age rocks of the Region 6 ROI. Shallow bedrock is present in 47 percent of the Region 6 ROI. The ROI in Region 6 does not contain mineral resources.

3.6.1.5.7 Region 7

Geologic hazards and mineral resources within Region 7 are summarized in Table 3.6.1-8. The ROI in Region 7 is an area of moderate to high seismic hazard, although there are no active surface faults located within the ROI. The PGA for HVDC Alternative Route 7-A is higher at 20 to 30 percent because it is closer to the New Madrid Seismic Zone. Approximately 99 percent of the soils in the ROI in Region 7 have high to very high liquefaction. Soils within the Tennessee Converter Station Siting Area have high liquefaction susceptibility.

In the ROI in Region 7, high susceptibility to landslides is present in most areas with incidence ranging from low to moderate. Moderate incidence occurs along HVDC Alternative Route 7-D. The Tennessee Converter Station Siting Area has a moderate incidence rate and a high susceptibility to landsliding because of the underlying lower Paleozoic interbedded shale and limestone and the localized significant slopes.

Table 3.6.1-8:
Geologic Hazards and Mineral Resources within the ROI—Region 7

Hazard/Mineral Resource	HVDC Alternative Route				APR Total	Tennessee Converter Station Siting Area
	AR 7-A	AR 7-B	AR 7-C	AR 7-D		
Geologic Hazards						
3.5–3.9 Earthquakes (number)[1]	17	11	11	11	11	11
4. + Earthquakes (number)[1]	7	7	7	7	7	15
High Susceptibility to Landslides and Low Incidence (acres and percentage of ROI)[2]	2,947 (56%)	203 (19%)	203 (7%)	0 (0%)	2,328 (45%)	0 (0%)
High Susceptibility to Landslides and Moderate Incidence (acres and percentage of ROI)[2]	0 (0%)	0 (0%)	1,240 (43%)	551 (69%)	504 (10%)	743 (100%)
High Susceptibility to Landslides and High Incidence (acres and percentage of ROI)[2]	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Table 3.6.1-8:
Geologic Hazards and Mineral Resources within the ROI—Region 7

Hazard/Mineral Resource	HVDC Alternative Route				APR Total	Tennessee Converter Station Siting Area
	AR 7-A	AR 7-B	AR 7-C	AR 7-D		
High-Very High Soil Liquefaction Potential (acres and percentage of ROI)[3]	5,181 (99%)	1,056 (100%)	2,887 (100%)	803 (100%)	5,165 (99%)	743 (100%)
Shallow Bedrock (acres and percentage of ROI)[4]	0 (0%)	91 (9%)	664 (23%)	83 (10%)	205 (4%)	226 (30%)
Mineral Resources						
Mineral Resources[5]	1	0	0	0	1	0

GIS Data Sources:
1 USGS (2008a)
2 USGS (2001)
3 CUSEC (2008)
4 NRCS 2013
5 USGS (2005b)

No known fossil bed sites were identified in Region 7. Shallow bedrock is limited to isolated areas of the Applicant Proposed Route and HVDC Alternative Routes 7-B, 7-C, and 7-D. About 30 percent of the Tennessee Converter Station Siting Area is underlain by shallow bedrock.

3.6.1.5.8 Connected Actions

3.6.1.5.8.1 Wind Energy Generation

3.6.1.5.8.1.1 Physiography, and Surface and Bedrock Geology

The WDZs are located in the Interior Plains Division in the vicinity of the AC collection system and the western part of Region 1. Elevations range from 950 feet above mean sea level (AMSL) to 4,800 feet AMSL. Three ecoregions with varying physiographic characteristics and surface geology are associated with the WDZs as described below:

- Canadian Cimarron Breaks—Nearly level, rolling, or hummocky plains. Elevation ranges from 2,400 to 4,800 feet AMSL. Local relief ranges from 10 to 120 feet. Surface geology consists of widely mantled Quaternary alluvium underlain by sand, gravel, silt, clay, and caliche (all WDZs except WDZ-L).
- Canadian Cimarron High Plains—Dissected canyons, hills, escarpments, buttes, terraces, and along rivers, dunes. Elevation ranges from 1,900 to 3,450 feet AMSL. Local relief ranges from 100 to 400 feet. Surface geology consists of Quaternary alluvium, colluvium, terrace deposits, and loess. Widely underlain by sand, gravel, silt, and clay (all WDZs except WDZ-L).
- Rolling Sand Plains—Gently undulating to hummocky, sandy plains with sand hills, depressions, and stabilized, partially stabilized, or active sand dunes. Locally, blow-outs occur. Small wetlands are found between dunes where the water table is high. Drainage networks are not well established. Elevation ranges from 2,400 to 4,800 feet AMSL. Local relief ranges from 10 to 120 feet. Surface geology consists of Quaternary sand and silt deposits that were laid down by rivers, and subsequently reworked by wind (WDZ-G and WDZ-I).
- The Anadarko Shelf and northern portion of the Anadarko Basin underlie the WDZs. Surface bedrock and geologic formations include undifferentiated Pleistocene and Pliocene deposits, undifferentiated Permian shale, sandstone and siltstone; Quaternary alluvial and playa deposits, Quaternary Blackwater Draw Formation Sand,

Tertiary interbedded sand, siltstone, clay, gravel lenses, caliche, and thin limestone of the Ogallala formation; and undifferentiated Mesozoic shale and sandstone.

3.6.1.5.8.2 Geologic Hazards, and Paleontological and Mineral Resources

Geologic hazards and mineral resources within the WDZs are summarized in Table 3.6.1-9. The WDZs are all located in an area of low earthquake activity and do not contain active surface faults. In the WDZs, incidence and susceptibility to landslides are both low because of the area's primarily flat topography. The WDZs are located in an area with numerous karst formations. Soil liquefaction is unlikely because of the low probable PGA.

Table 3.6.1-9:
Geologic Hazards and Mineral Resources within the ROI—Wind Development Zones

Hazard/Mineral Resource	WDZ											
	A	B	C	D	E	F	G	H	I	J	K	L
Area (acres)	109,747	125,479	161,048	69,189	47,092	112,461	187,315	116,226	105,203	92,567	92,894	165,848
Geologic Hazards												
3.5–3.9 Earthquakes[1] (number)	1	2	2	0	0	1	1	0	0	0	1	3
4. + Earthquakes (number)[1]	1	1	1	1	1	1	0	0	1	1	1	1
Karst Formation (acres)[2]	93,920 (86%)	53,123 (42%)	140,395 (87%)	35,765 (52%)	184 (<1%)	0 (0%)	119,576 (64%)	66,643	39,207 (57%)	17,560 (19%)	28,947 (31%)	118,751 (72%)
Shallow Bedrock (acres)[3]	4,762 (4%)	2,306 (2%)	6,565 (4%)	8,037 (12%)	4,318 (9%)	6,631 (6%)	1,117 (1%)	7,892 (7%)	202 (<1%)	9,772 (11%)	0 (0%)	11,911 (7%)
Mineral Resources												
Oil and Gas Wells[4]	0	0	0	0	0	0	32	0	1	75	62	0
Mineral Resources[5]	0	0	0	8	8	15	2	18	4	14	11	0

GIS Data Sources:
1 USGS (2008a)
2 Tobin and Weary (2004)
3 NRCS (2013)
4 AOGC (2014)
5 USGS (2005b)

No known fossil bed sites were identified in the WDZs. The approximate percentages of shallow bedrock contained within the WDZs range from 0 to 12 percent.

3.6.1.5.8.3 Optima Substation

The general geologic and related features in the area of the future Optima substation are the same as described for the western area of Region 1. Seismicity characteristics are low. The entire Optima substation is within karst, and shallow bedrock is present in 15 acres (9 percent of the 160-acre site). Mineral resources are not present in the siting area.

3.6.1.5.8.4 TVA Upgrades

As described above under Section 3.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.6.1.6 Impacts to Geology, Paleontology, and Minerals

3.6.1.6.1 Methodology

The impact analysis area for geologic, mineral, and paleontological resources includes the Project components. Analysis was based on review of publicly available government documents and published literature as well as comments from scoping as described in Table 3.6.1-10.

Table 3.6.1-10:
Impacts Analysis Considerations and Relevant Assumptions

Resource Topic	Analysis Considerations and Relevant Assumptions
Geologic Hazards	Evaluate potential impact to the Project from geologic hazards that include seismicity, landslides, subsidence related to karst, and liquefaction. Evaluate risk to nearby populations from any increases in geologic hazards caused by the Project. Major assumptions in the analysis of the risk to the Project because of geological hazards include the following: • The location of active faults is based on information available from GIS Data Source: USGS (2008). Ground motion estimates are based on recent updates of the USGS seismic hazard mapping by the USGS. Quaternary faults are numerous in the impact analysis area, and may rupture at any time. Only those faults that have moved in the last 15,000 years, however, are considered to be active as determined by the GIS Data Source: USGS (2008). • Landslide risk information is based on landslide maps, landslide incident and susceptibility areas, and USGS-prepared Landslide Inventory Maps (GIS Data Source: USGS 2001).
Mineral Resources	Analyze the Applicant Proposed Route and HVDC Alternative Routes with regard to potential interference with existing mineral extraction operations, reduced access to underlying minerals, and interference with future mineral extraction operations.
Paleontological Resources	Evaluate the potential for loss of important fossils because of the following activities or conditions: • Ground-disturbing activities such as clearing, grading, and foundation excavation • Operations and maintenance activities that would require disturbance of previously undisturbed areas within the established ROW

The following impacts could occur as result of the construction, operations and maintenance, and decommissioning of the Project components:

- Damage or interruption of services from seismicity, landslides, subsidence, or liquefaction generated during ground-disturbing activities; or damage from these hazards that interferes with construction of the Project
- Loss or inaccessibility of mineral resources of economic value for future use
- Loss or damage to scientifically important paleontological resources

The Applicant would adopt the EPMs listed in Appendix F. EPMs that would specifically avoid or minimize the potential for impacts on geology, paleontology, and minerals are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).

- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.

In addition, Clean Line will develop the following plans to avoid or minimize effects to geology, paleontology, and minerals from construction, operations and maintenance, or decommissioning as appropriate:

- Blasting Plan: This plan will describe measures designed to minimize adverse effects due to blasting.
- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, will described the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas. The SWPPP will be required to minimize adverse effects from erosion during ground disturbing activity.
- Restoration Plan: This plan will describe post-construction activities to reclaim disturbed areas. This plan will be required to minimize adverse effects associated with areas (particularly slopes) exposed during construction.

3.6.1.6.1.1 Impacts Common to All Alternatives

3.6.1.6.1.1.1 Construction Phase

The following impacts could occur as result of the construction of the Project:

- Damage or interruption of services resulting from seismicity, landslides, subsidence, or liquefaction generated during ground-disturbing activities
- Loss or damage to scientifically important paleontological resources
- Loss or inaccessibility of mineral resources of economic value for future use

In addition, geologic hazards could affect construction and use of access roads, but to a small extent given the simplicity of road construction. Construction and use of access roads is not likely to affect access to mineral resources, though pre-planning for the road routes would need to occur to avoid crossing locations of existing mineral resources (i.e., oil or gas well locations, or other actively mined sites).

Seismic Hazards

While it is not likely that services would be damaged or interrupted by seismic activity, the Applicant would construct Project components to withstand probable seismic events within the seismic risk zones crossed and comply with all applicable federal and state regulations and requirements to prevent accidents and ensure adequate protection for the public and the Project.

Landslides

While it is not likely that services would be damaged or interrupted by landslides, the Applicant would design Project components to avoid loading of slopes. Where unstable slopes cannot be avoided, construction activities, including vegetation clearing and alteration of surface drainage patterns, may increase landslide risk. Erosion control measures and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas would be implemented per the Project SWPPP. In addition, areas subjected to clearing and grading would be stabilized and/or revegetated consistent with the Applicant's Restoration Plan and landowner or land manager requirements. Implementation of EPMs GE-9, GE-27, and GEO-1 would minimize the direct effects of landslides.

Blasting

During construction, blasting may be necessary in areas of shallow bedrock. Softer sedimentary rocks can generally be removed without blasting, but if blasting is required as determined by a geotechnical study (to be completed as part of the engineering design), a Blasting Plan would be developed. Blasting and removal of shallow bedrock has the potential to impact paleontological resources and would be avoided or minimized during engineering design.

Subsidence

The Applicant would complete geologic/geotechnical investigations during engineering design to reduce the potential for impacts related to karst. The presence of karst can cause subsidence that could damage Project infrastructure and result in the temporary failure of the electric transmission system. The placement of Project components would be governed in part by site conditions and construction requirements, which would minimize the risks associated with constructing the Project across karst. In general, placement of Project infrastructure would avoid areas of identified karst if feasible. If it is not feasible to avoid karst in some areas, measures such as specialized foundation design, filling of subsidence areas, and/or more frequent monitoring protocols would be implemented as appropriate.

Liquefaction

The Applicant would complete geologic/geotechnical investigations during the engineering design in the areas identified as containing high susceptibility to soil liquefaction to reduce potential impacts to the Project components. Areas of high liquefaction potential might increase the risk of damage to Project infrastructure from earthquakes and subsequent destabilization of underlying soils. The placement of Project components would be governed in part by site conditions and construction requirements, which would minimize risks related to soil liquefaction. If it is not feasible to avoid areas of high liquefaction, measures such as specialized foundation design, specialized fill materials, and additional monitoring protocols following seismic events would be implemented as appropriate.

Paleontological Resources

A direct impact to fossil resources would be loss during ground-disturbing activities such as clearing, grading, and excavation. These impacts could occur where fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Indirect impacts during construction would include erosion of fossil beds due to slope re-grading and vegetation clearing or the unauthorized collection of scientifically important fossils by construction workers or the public due to increased access to fossils along the ROW. These impacts could occur where fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Grading activities would be limited to the minimum amount needed to create safe working surfaces, and foundation excavations would typically be made using a power drill or auger, which would reduce the potential for impact to paleontological resources.

Mineral Resources

A direct impact to mineral resources would occur if construction activities were to interfere with ongoing mineral extraction operations, reduce access to underlying resources, or interfere with future access to mineral extraction operations. Impacts to mineral resources would be avoided or minimized during the design phase of the Project by avoiding mineral resource features and maintaining access to identified mineral resources. EPMs LU-1, GE-29, and LU-3 would be implemented to avoid or minimize potential impacts to mineral resources from construction.

3.6.1.6.1.1.2 Operations and Maintenance Phase

Overall impacts during the operations and maintenance phase of the Project would be similar, but would have a much smaller degree of impact as the construction phase. Seismic activity could impact Project infrastructure and cause service interruptions. Design standards for specific seismic concerns would avoid and minimize such impacts. The engineering design would avoid or minimize potential effects from karst. No blasting would take place during operation and maintenance of the Project. Project infrastructure would avoid impacts to active mineral resources features and would not preclude development of underground mineral resources in most cases.

3.6.1.6.1.1.3 Decommissioning Phase

During the removal of Project components, some ground disturbance would occur from the use of machinery such as bulldozers to demolish facility buildings or cranes used to deconstruct the transmission structures. However, ground disturbance would be limited to near surface depths in areas previously disturbed during the construction and operation phases. EPMs used during construction would be applied during decommissioning, and the amount of ground disturbance associated with decommissioning would be less than during construction. Overall impacts during the decommissioning phase of the Project would be similar as the construction phase. Because the Project infrastructure would be removed, there would be complete access to mineral resources.

3.6.1.6.2 Impacts Associated with the Applicant Proposed Project

In general, the Applicant Proposed Project would not affect geologic features or resources of the area. Construction activities would require the removal or surface disturbance of small amounts of near-surface materials. This would have no measurable impact on geologic resources or features for any of the components of the Applicant Proposed Project. Similarly, the Project would have minimal impact on paleontology or mineral resources. However, geologic hazards could cause potential impacts to the Project depending on the final location of the specific facilities in relationship to these hazards. The implementation of EPMs and appropriate engineering design would reduce or eliminate impacts from such hazards.

3.6.1.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.6.1.6.2.1.1 Construction Impacts

3.6.1.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Subsidence from karst is a possible geologic hazard of concern within the Oklahoma Converter Station Siting Area. Implementation of EPMs and appropriate engineering design, including geotechnical investigations, would avoid or minimize the potential for impacts from karst. No known fossil bed sites were identified in the Oklahoma Converter Station Siting Area. About 40 percent of the siting area is located in the shallow bedrock, however, so grading and excavation activities could cause direct impacts to paleontological resources if fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock.

3.6.1.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

The Tennessee converter station and AC interconnection would be constructed to withstand probable seismic events in the moderate to high seismic hazard zones. They would be constructed in accordance with applicable federal and state regulations and requirements to prevent accidents and to ensure adequate protection for the public and the Project components. All of the soils within the Tennessee Converter Station Siting Area have high liquefaction potential, which could contribute to unstable conditions and potential structural damage during seismic events.

Appropriate placement of Project components following completion of geologic/geotechnical investigations during engineering design would minimize risks related to soil liquefaction.

The Applicant would implement EPMs GE-9, GE-27, and GEO-1 to minimize the direct effects of landslides in this area of moderate susceptibility and low incidence. About 30 percent of the siting area is located in shallow bedrock, and blasting may be required. Impacts would be minimized by appropriate engineering design and through implementation of the Blasting Plan.

3.6.1.6.2.1.2 Operations and Maintenance Impacts

3.6.1.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

Impacts from geological hazards or to mineral resources are not anticipated during operations and maintenance because the area is located in an area of low seismic risk, soil liquefaction risk is expected to be low, and no mineral resources are located within the siting area.

3.6.1.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

The Project components would be operated and maintained in an area of moderate to high seismic hazard, and expected ground motions from an earthquake would be moderate to high given the proximity of the New Madrid Seismic Zone. Damage from earthquakes with would be negligible to minimal in structures designed in accordance with seismic protection standards. The Project components would be constructed to withstand probable seismic events and constructed in accordance applicable federal and state regulations to prevent accidents and to ensure adequate protection for the public and the Project.

Soils within the siting areas have high liquefaction potential. Geotechnical investigations would be completed in these areas during engineering design. The placement of Project components would be governed in part by site conditions, construction requirements, and EPMs, which would minimize risks related to soil liquefaction.

3.6.1.6.2.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1.

3.6.1.6.2.2 AC Collection System

3.6.1.6.2.2.1 Construction Impacts

In the area of the AC collection system, the excavation and drilling required for the foundations of the transmission structures would permanently impact the geologic formation underneath the structure footprint to depths ranging from 30 to 45 feet. Specific foundation depths would depend on the specific geotechnical conditions and the engineering design. The area of potential impact to a geologic formation represents a very small portion of the total area of the geologic formation. The total areal extent of transmission structure footprints for the AC collection system routes are estimated to range from 1.7 acres (AC Collection System Route SE-2) to 7.1 acres (AC Collection System Route NW-2), which is a conservative estimate of the areal extent of affected geologic formations.

Table 3.6.1-11 summarizes the geologic hazards and mineral resources that could potentially impact or be impacted by the AC collection system routes.

The AC collection system is located in Region 1, which, west to east, is an area of low earthquake activity and does not contain active surface faults. The USGS seismic hazard mapping indicates that in areas crossed by the Project in

Region 1, the likelihood of ground movement that could be triggered by a maximum credible earthquake is expected to be low. Incidence and susceptibility to landslides are low for the AC collection system. Soil liquefaction is generally not a concern in this portion of the Project due to the low seismic activity and low PGA. Based on the existing conditions, earthquakes, landslides, and liquefaction are not anticipated to impact the AC collection system routes.

Table 3.6.1-11:
Geological Hazards and Mineral Resources Impacts—AC Collection System Routes

Route	Analysis Area (acres)	Geologic Hazard (within 200 feet of representative centerline)		Mineral Resources (based on representative centerline)[3]
		Karst Formation[1]	Shallow Bedrock[2]	
E-1	708	198 acres	138 acres	Intersects 1 mineral resource. 12 oil and gas wells and 4 mineral resources within 2 miles.
E-2	974	682 acres	81 acres	19 oil and gas wells and 8 mineral resources are located within 2 miles of the representative centerline.
E-3	977	577 acres	117 acres	15 oil and gas wells and 8 mineral resources are located within 2 miles of the representative centerline.
NE-1	730	463 acres	63 acres	8 mineral resources are located within 2 miles of the representative centerline.
NE-2	637	300 acres	119 acres	7 mineral resources are located within 2 miles of the representative centerline.
NW-1	1,265	510 acres	64 acres	4 oil and gas wells and 9 mineral resources are located within 2 miles of the representative centerline.
NW-2	1,365	1,125 acres	71 acres	7 mineral resources are located within 2 miles of the representative centerline.
SE-1	979	611 acres	69 acres	5 oil and gas wells are located within 2 miles of the representative centerline.
SE-2	325	325 acres	66 acres	1 mineral resource is located within 2 miles of the representative centerline.
SE-3	1,194	901 acres	81 acres	144 acres of shale gas play are traversed by the alternative representative centerline; 43 oil and gas wells and 7 mineral resources located within 2 miles of the representative centerline.
SW-1	326	326 acres	66 acres	3 mineral resources are located within 2 miles of the representative centerline.
SW-2	901	213 acres	86 acres	3 mineral resources are within 2 miles of the representative centerline.
W-1	508	128 acres	43 acres	6 mineral resources are within 2 miles of the representative centerline.

GIS Data Sources:
1 Tobin and Weary (2004)
2 NRCS (2013)
3 USGS (2005b) (metallic and non-metallic mineral resources); EIA (2011a); OCC (2013)

Karst covers about 60 percent of the AC collection system route representative ROWs. The final location of a ROW would be designed to avoid or minimize impacts to karst areas. Shallow bedrock underlies 5 to 20 percent of each AC collection system route ROW, and blasting may be necessary in this area.

Only the AC Collection System Routes E-1 and SE-3 representative centerlines traverse mineral resources (mineral deposit and shale gas play). EPMs LU-1, GE-29, and LU-3 would be implemented to avoid or minimize potential impacts to mineral resources.

3.6.1.6.2.2.2 Operations and Maintenance Impacts

Impacts to geology, paleontology, and mineral resources resulting from the operation and maintenance of the AC Collection System Routes would be minor during construction because ground disturbing activities would be comparatively negligible. The implementation of EPMs and appropriate engineering design would minimize or prevent impacts from geologic hazards during operation and maintenance. With implementation of EPMs (LU-1, GE-29, and LU-3) potential impacts to mineral resources would be avoided or minimized.

3.6.1.6.2.2.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1.

3.6.1.6.2.3 HVDC Applicant Proposed Route

3.6.1.6.2.3.1 Construction Impacts

Table 3.6.1-12 summarizes geologic hazards and mineral resources that could be potentially impacted by or impact the Applicant Proposed Route. The excavation and drilling required for the foundations of the transmission structures would permanently impact the geologic formation underneath the transmission structure footprint to depths ranging from 30 to 45 feet in most areas of the Applicant Proposed Route. In the area of the Mississippi River crossing, foundation depths could reach 114 to 132 feet deep for lattice structures and 83 to 95 feet for pole structures. The area of potential impact to a geologic formation represents a very small portion of the total area of the geologic formation. In areas of karst formations, excavation and drilling could potentially create new preferential flow pathways, which could increase the risk of introducing constituents into the karst system that could eventually impact groundwater quality. The total estimated transmission structure footprints by region range from 5.4 to 20.4 acres, which is a conservative estimate of the areal extent of affected geologic formation. In total, the tower footprints would affect about 90.6 acres of geologic formation for the entire Applicant Proposed Route.

3.6.1.6.2.3.1.1 Seismicity

No active faults are present in Regions 1 and 2, and expected ground motions from an earthquake would be low, so seismicity impacts are expected to be minimal in the representative ROW for the Applicant Proposed Route. Although one active fault is present in Region 3 and three active surface faults are present in Region 4, the expected ground motions from an earthquake would be low. Two active surface faults transect the Applicant Proposed Route in Region 5 and expected ground motions from an earthquake would be low to moderate. Earthquake hazard transitions from low to moderate with eastward progression along Region 5. No active surface faults are present in Region 6, and expected ground motions from an earthquake would be low to high. From west to east within Region 6, the earthquake hazard transitions from low to moderate and from moderate to high. The Applicant Proposed Route in the easternmost portion of Region 6 is located within moderate to high seismic hazard that is closer to the New Madrid Seismic Zone. No active surface faults are present in Region 7, but expected ground motions from an earthquake would be moderate to high given the proximity of the New Madrid Seismic Zone.

With proper engineering design, impacts from seismicity are anticipated to be minimal for the Applicant Proposed Route. The Project would be constructed to withstand probable seismic events within the seismic risk zones crossed and constructed in accordance with all applicable federal and state regulations to prevent accidents and to ensure adequate protection for the public and the Project.

3.6.1.6.2.3.1.2 Soil Liquefaction

Soil liquefaction is unlikely in Regions 1 and 2 because of the low probable PGA. Approximately 15 percent of the soils within the Applicant Proposed Route representative ROW in Region 4 have high liquefaction susceptibility and approximately 4 percent of the soils within the easternmost portion of the Applicant Proposed Route in Region 5 have high liquefaction susceptibility. Approximately 90 percent of the soils within the Region 6 Applicant Proposed Route representative ROW have high liquefaction susceptibility; and approximately 98 percent of the soils within the Region 7 Applicant Proposed Route have high or very high liquefaction susceptibility. The proper placement of Project components following completion of geologic/geotechnical investigations performed during engineering design would minimize risks related to soil liquefaction.

3.6.1.6.2.3.1.3 Landslides

Regions 1 and 2 have a generally low incidence and low susceptibility to landslides, so impacts to the Project from landslides are not anticipated. The Applicant Proposed Route in Region 3 has low incidence for landslides, but susceptibility ranges from low to high. Region 4 is characterized by moderate susceptibility to landsliding and low incidence. Region 5 is characterized by moderate susceptibility to landsliding and low incidence with the exception of the very easternmost area of the region, where landslides are low incidence and high susceptibility. In Region 6, incidence and susceptibility to landslides are both low. High susceptibility areas are located in most areas of the Applicant Proposed Route in Region 7. Implementation of EPMs and appropriate engineering design would minimize impacts from areas susceptible to landslides.

3.6.1.6.2.3.1.4 Karst Formations

Karst is present over about 25 percent of the Applicant Proposed Route representative ROW in Region 1. Isolated areas of karst occur in the western area of Region 2 of the Applicant Proposed Route. The remainder of the Applicant Proposed Route in Region 2 does not contain identified karst formations and therefore has a low susceptibility related land subsidence. Region 3 does not contain any identified karst formations. Region 4 contains karst formations in the western area of the Applicant Proposed Route (12 percent of the representative ROW). The Applicant Proposed Route contains isolated pockets of karst in Region 5 in the easternmost area. Regions 6 and 7 do not contain karst formations. Karst is present in a larger percentage of the ROI than the impact areas in Regions 2 and 4; and that karst is present in the ROI in Region 5 but is not present in the impact area for Region 5. Depending on the final location of the Applicant Proposed Route in these regions, impacts to karst might be expected to vary from what is presented in the table. EPMs and appropriate engineering design would focus on avoiding karst and maintaining ground disturbance over as small an area as possible to reduce impacts.

Table 3.6.1-12:
Geologic and Mineral Resources Impacts—200-Foot Representative ROW of the Applicant Proposed Route

Parameter	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
Impact Area (acres)	2,826	2,589	3,950	3,088	2,760	1,331	1,048
Seismicity[1]	No active faults; low ground motion potential (PGA of 1% of gravity)	No active faults; low ground motion potential (PGA of 1–2% of gravity)	1 active fault; low ground motion potential (PGA of 2–3% of gravity)	3 active faults; low ground motion potential (PGA of 2–4% of gravity)	2 active faults; low to moderate ground motion potential (PGA of 4–10% of gravity)	0 active faults; low to high ground motion potential (PGA of 10–30% of gravity)	0 active faults; moderate to high ground motion potential (PGA of 15–30% of gravity)
Landslides[2]	Incidence and susceptibility to landslides are both low	Incidence and susceptibility to landslides are both low	High susceptibility, Low incidence (122 acres or 3%) Moderate susceptibility, Low incidence (204 acres or 5%)	Moderate susceptibility, Low incidence (2,650 acres or 86%)	High susceptibility, Low incidence (112 acres or 4%) Moderate susceptibility, Low incidence (2,513 acres or 91%)	Incidence and susceptibility to landslides are both low	High susceptibility, Moderate incidence (100 acres or 10%) High susceptibility, Low incidence (468 acres or 45%) Low incidence (480 acres or 46%)
Subsidence (karst)[3]	690 acres (24%)	189 acres (7%)	No Karst	678 acres (22%)	308 (11%)	No Karst	No Karst
Liquefaction[4]	Low	Low	Low	High (431 acres or 14%) Moderate (163 acres or 5%) Very Low (1,430 acres or 46%)	High (262 acres or 9%) Very Low (2,498 acres or 91%)	Very High (358 acres or 27%) High (889 acres or 67%) Moderate (84 acres or 6%)	Very High (737 acres or 70%) High (296 acres or 28%)
Mineral Resources (shale gas plays acres, oil/gas wells)[5]	No Resources	521 acres (20%)	12 oil/gas wells	1,929 acres (62%), 6 oil/gas wells	2,778 acres (95%), 10 oil/gas wells	No mineral resources	No mineral resources
Shallow Bedrock[6]	328 acres (12%)	775 acres (30%)	2,227 acres (56%)	1,974 acres (64%)	2,398 acres (87%)	622 acres (46%)	54 acres (5%)

GIS Data Sources:
1 Garrity and Soller (2009) and USGS (2008b)
2 USGS (2001)
3 Tobin and Weary (2004).
4 CUSEC (2008)
5 OCC (2013), AOGC (2014), USGS (2005b), EIA (2011a). Oil and gas wells and mineral resources are present in the larger ROI. EIA (2011a)
6 NRCS (2013). Shallow bedrock is present in 18% of the larger ROI.

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3.6.1.6.2.3.1.5 Shallow Bedrock

Shallow bedrock underlies 12 percent of the Applicant Proposed Route representative ROW in Region 1 and 30 percent in Region 2. Shallow bedrock is present within 56 percent of the Applicant Proposed Route representative ROW in Region 3; within 63 percent of the Applicant Proposed Route representative ROW in Region 4; within 87 percent in Region 5; within 46 percent in Region 6; and within 4 percent in Region 7. Blasting may be required in these areas and impacts would be minimized by following provisions of the Blasting Plan. Depending on the final location of the Applicant Proposed Route, impacts in areas of shallow bedrock might be expected to vary from what is presented in the table.

3.6.1.6.2.3.1.6 Paleontological Resources

Although no known fossil bed sites were identified in the representative ROW in any of the Applicant Proposed Route Regions, shallow bedrock is present throughout the Project and there is the potential for fossil resources to be impacted. Areas of the Project that have a high percentage of shallow bedrock would have a greater potential for impacting paleontological resources. The Applicant would avoid or minimize impacts on paleontological resources by training personnel in the practices, techniques, and protocols required by federal and state regulations and applicable permits (GE-1).

3.6.1.6.2.3.1.7 Mineral Resources

The Applicant Proposed Route in Region 1 traverses no shale gas plays within the representative ROW. Shale gas plays (1,428 acres) are traversed in Region 2. The route does not traverse any oil and gas wells in Regions 1 and 2. The Applicant Proposed Route representative ROW in Region 3 traverses 12 oil and gas wells. The Applicant Proposed Route in Region 4 would traverse 1,929 acres of shale gas plays and six oil and gas wells. Ten oil and gas wells and 2,630 acres of shale gas plays are traversed in the Applicant Proposed Route representative ROW of Region 5. No mineral resources are traversed by the Applicant Proposed Route representative ROWs for Regions 6 and 7, so no impacts to mineral resources are indicated. EPMs LU-1, GE-29, and LU-3 would be implemented to avoid or minimize impacts to mineral resources.

3.6.1.6.2.3.2 Operations and Maintenance Impacts

Impacts from the Applicant Proposed Route during operations and maintenance would be less than impacts described during construction. Once construction has been completed, blasting would not occur and other soil-disturbing activities would be negligible; thus, impacts to fossils and karst are not anticipated. Operations and maintenance activities would not increase the risk of landslides.

Given the implementation of the appropriate EPMs and engineering design, the Applicant Proposed Route is not anticipated to be impacted by seismicity, subsidence, liquefaction, or landslides that results in damage to Project infrastructure or interruption of service; the Applicant Proposed Route would not adversely impact access to mineral resources; and impacts to paleontological resources would be minimized. Regions 6 and 7 are located in an area of low to high seismic risk and high potential for liquefaction; therefore, there is still potential that seismicity and liquefaction could impact Project infrastructure; however, EPMs and appropriate engineering design would reduce the risk.

3.6.1.6.2.3.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1. Because minor ground disturbance associated with construction and operations and maintenance would no longer be necessary and because structure foundations would only be removed below ground level, the potential to affect paleontological resources would be reduced.

3.6.1.6.3 Impacts Associated with the DOE Alternatives

3.6.1.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.6.1.6.3.1.1 Construction Impacts

The Arkansas converter station and AC interconnection would be located near the New Madrid Seismic Zone in an area of low to moderate seismic hazard. One active surface fault traverses the siting areas. All of the soils within the siting area for the Arkansas converter station have high liquefaction potential, and about 60 percent of the soils within the AC interconnection have high liquefaction potential. To reduce impacts from seismic hazard and liquefaction, the Applicant would implement the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Siting Area.

The Arkansas Converter Station and AC Interconnection Siting Areas do not contain karst, so no impacts from karst are anticipated during construction. The areas have moderate susceptibility and low incidence with respect to landslides. Potential landslide impacts would be reduced or mitigated using the same techniques as described for the Tennessee Converter Station Siting Area and AC Interconnection Siting Area.

Approximately 82 percent of the Arkansas Converter Station Siting Area is underlain by shallow bedrock (Table 3.6.1-6). Impacts from blasting would be minimized by following provisions of the Blasting Plan.

EPMs LU-1, GE-29, and LU-3 would be implemented to avoid or minimize potential impacts to mineral resources from construction.

3.6.1.6.3.1.2 Operations and Maintenance Impacts

The Arkansas Converter Station Siting Area and AC Interconnection Siting Area have moderate susceptibility and low incidence with respect to landslides. If operations and maintenance activity is conducted on unstable slopes, including vegetation clearing and alteration of surface-drainage patterns, landslide risk would be increased. Effects would be minimized utilizing the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Siting Area. The Project components would be operated and maintained in an area of low to moderate seismic hazard. The soils within the siting areas have high liquefaction potential. Impacts from seismic hazards and liquefaction would be minimized utilizing the same measures as described for the Tennessee Converter Station Siting Area and AC Interconnection Siting Area.

Once construction has been completed, blasting and other soil-disturbing activities would be negligible, so impacts to fossils are not anticipated. The siting areas do contain oil and gas wells or other mineral resources.

3.6.1.6.3.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.1.6.1.

3.6.1.6.3.2 HVDC Alternative Routes

3.6.1.6.3.2.1 Construction Impacts

3.6.1.6.3.2.1.1 Region 1

Table 3.6.1-13 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by all the Region 1 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. HVDC alternative route impacts in Region 1 related to active faults, ground motion potential, landslides, and mineral resources are comparatively the same as the Applicant Proposed Route, and these geologic hazards are not presented in Table 3.6.1-13.

Table 3.6.1-13:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 1

Parameter	Impact Area (acres)	Subsidence (acres of karst)[1]	Shallow Bedrock[2]	Impacts Comparison with Applicant Proposed Route Corresponding Links
AR 1-A[3]	3,004	244 (8%)	582 (19%)	Greater impact to karst formations and shallow bedrock.
Corresponding APR Links 2, 3,4, 5	2,778	No karst	299 (10%)	NA
AR 1-B[3]	1,268	437 (34%)	100 (8%)	Lesser impact to karst formation and more impact to shallow bedrock.
Corresponding APR Links 2, 3	1,316	643 (49%)	40 (3%)	NA
AR 1-C[3]	1,272	242 (19%)	63 (5%)	Lesser impact to karst formations and more impact to shallow bedrock.
Corresponding APR Links 2, 3	1,316	643 (48%)	40 (3%)	NA
AR 1-D[3]	819	No karst	46 (6%)	More impact to shallow bedrock.
Corresponding APR Links 3, 4	823	No karst	25 (3%)	NA

GIS Data Sources:
1 Tobin and Weary (2004).
2 NRCS (2013)
3 Oil and gas wells and mineral resources are present in the larger ROI area (GIS Data Sources: USGS [2005a] and OCC [2013]).

Representative ROWs in Region 1, except for Alternative Route 1-D and Applicant Proposed Route Links 1 and 2, have isolated areas of karst formations. The presence of karst and potential need for blasting in areas of shallow bedrock would require the use of EPMs and appropriate engineering design to reduce the potential for impacts. No known fossil bed sites were identified in Region 1. No mineral resources are traversed in Region 1. However, oil and gas wells and mineral resources are present in the larger ROI areas for all of the HVDC alternative routes and corresponding Applicant Proposed Route links. Depending on the final route locations, mineral resources have the potential to be affected in these areas.

3.6.1.6.3.2.1.2 Region 2

Table 3.6.1-14 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the HVDC alternative routes compared to the corresponding Applicant Proposed Route links. HVDC alternative route impacts in Region 2 related to active faults, ground motion potential, landslides, and soil liquefaction are comparatively the same as the Applicant Proposed Route, and these geologic hazards are not presented in Table 3.6.1-14.

Table 3.6.1-14:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 2

Parameter	Impact Area (acres)	Subsidence[1] (acres of karst)	Mineral Resources (acres of shale gas play)[2]	Shallow Bedrock (acres)[3]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 2-A	1,396	310 (22%)	0 (0%)	0 (0%)	More impact to karst formation less impact to shallow bedrock, and less impact to shale gas deposits.
Corresponding APR Link 2	1,331	189 (14%)	521 (39%)	296 (22%)	NA
AR 2-B	728	0 (0%)	0 (0%)	550 (76%)	More impact to soils with shallow bedrock and less impact to karst formations.
Corresponding APR Link 3	764	0 (0%)	0 (0%)	180 (24%)	NA

GIS Data Sources:
1 Tobin and Weary (2004).
2 EIA (2011a)
3 NRCS (2013). In HVDC Alternative Route 2-A, shallow bedrock is present in 22% of the larger ROI in HVDC Alternative Route 2-A, and in HVDC Alternative Route 2-B, shallow bedrock is present in 41% of the larger ROI.

Isolated areas of karst formations (22 percent of the total area of the representative ROW) occur in HVDC Alternative Route 2-A and Applicant Proposed Route Link 2 (14 percent). The remainder of Region 2 does not contain identified karst formations and therefore has a low susceptibility for land subsidence as a result of karst formations. There is potential for direct impacts to paleontological resources in areas of shallow bedrock (76 percent for HVDC Alternative Route 2-B). Shale gas plays are traversed along the Applicant Proposed Route Link 2, but are not traversed along the corresponding HDVC Alternative Route 2-A. There are no other mineral resources traversed in the Region 2 representative ROWs.

3.6.1.6.3.2.1.3 Region 3

Table 3.6.1-15 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 3 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. There are no karst formations present in any of the routes of Region 3, and soil liquefaction is unlikely because of the low probable PGA. All HVDC alternative route impacts in Region 3 related to these geologic hazards are therefore comparatively the same as the Applicant Proposed Route, and these geologic hazards are not presented in Table 3.6.1-15.

Although one active fault is present in Region 3, the earthquake and seismic activity are low within Region 3 and potential related impacts are expected to be minimal. HVDC Alternative Routes 3-C, 3-D, and 3-E, are located in areas with low incidence for landslides, but where susceptibility ranges from low to high. There are no appreciable differences (Table 3.6.1-15) between the Region 3 HVDC alternative routes and corresponding Applicant Proposed Route links in terms of the low potential seismic ground motion and landslide risks.

Shallow bedrock is present along all routes, and blasting may be required in these areas. There is potential for direct impacts to paleontological resources in areas of shallow bedrock (33 to 74 percent for the HVDC Alternative Routes). All of the alternative routes in Region 3 traverse shale gas plays, but no other mineral resources are traversed.

Table 3.6.1-15:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 3

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Mineral Resources (acres of shale gas play)[3]	Shallow Bedrock (acres)[4]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 3-A	919	No active faults; low ground motion potential (PGA of 2–3% of gravity)	Incidence and susceptibility to landslides are both low	0 (0%)	681 (74%)	Crosses nearly the same amount of shallow bedrock.
Corresponding APR Link 1	977	Same as AR 3-A	Same as AR 3-A	0 (0%)	696 (71%) — greater impact	NA
AR 3-B	1,167	Same as AR 3-A	Same as AR 3-A	0 (0%)	852 (73%)	Crosses nearly the same amount of shallow bedrock.
Corresponding APR Links 1,2, 3	1,221	Same as AR 3-A	Same as AR 3-A	0 (0%)	838 (21%) —less impact	NA
AR 3-C	2,968	Same as AR 3-A	Low incidence mod-high susceptibility (318 acres and 11%)	0 (0%)	1,481 (50%)	Crosses nearly the same amounts of shallow bedrock and landslide susceptibility is nearly the same.
Corresponding APR Links 3, 4, 5, 6	2,896	Same as AR 3-A	Low incidence and mod-high susceptibility (326 acres and 11%)	12 oil/gas wells - greater impact	1,490 (51%) — greater impact	NA
AR 3-D	959	Same as AR 3-A	Low incidence, mod-high susceptibility (318 acres and 33%)	0 (0%)	320 (33%)	Crosses more amounts of shallow bedrock; landslide susceptibility is nearly the same.
Corresponding APR Links 5,6	857	1 active fault; low ground motion potential—greater impact	Low incidence, mod-high susceptibility (326 acres and 38%)	0 (0%)	268 (31%) —less impact	NA
AR 3-E	208	Same as AR 3-A	100% of route is low incidence and moderate susceptibility (208 acres and 100%)	0 (0%)	112 (54%)	Crosses nearly the same amounts of shallow bedrock; landslide susceptibility is nearly the same.
Corresponding APR Links 6	190	Same as AR 3-A	Same as AR 3-E	0 (0%)	98 (52%) —less impact	

GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001) (a) High susceptibility and low incidence is 41% in the larger ROI for Alternative Route 3-C.
3 OCC (2013), EIA (2011a)
4 NRCS (2013)

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3.6.1.6.3.2.1.4 Region 4

Table 3.6.1-16 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 4 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. Four active surface faults are present in Region 4, but expected ground motions from an earthquake would be low and any related impacts would be minimal. HVDC Alternative Routes 4C, 4-D, and 4-E and the corresponding Applicant Proposed Route links contain areas of high liquefaction susceptibility. The appropriate placement of project components during engineering design would minimize risks related to soil liquefaction.

Region 4 is characterized by moderate susceptibility to landsliding and low incidence. HVDC Alternative Routes 4-A through 4-D representative ROWs contain greater amount of landslide hazard than the corresponding Applicant Proposed Route links. HVDC Alternative Routes 4-A and 4-B have isolated areas of karst formations covering about 59 and 54 percent of the respective representative ROWs. The corresponding links of the Applicant Proposed Route have slightly lower amounts of karst formations within the representative ROWs.

Shallow bedrock is present along all alternative routes, and blasting may be required in these areas. There is potential for direct impacts to paleontological resources in areas of shallow bedrock (57 to 100 percent for the HVDC Alternative Routes in Region 3). Oil and gas wells and shale gas plays are traversed in Region 4.

3.6.1.6.3.2.1.5 Region 5

Table 3.6.1-17 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 5 HVDC alternative routes compared to the corresponding Applicant Proposed Route links. There are no karst formations present in all route areas of Region 5, so karst is not presented in Table 3.6.1-17. However, karst is present in the larger ROIs for HVDC Alternative Route 5-D (73 percent of ROI) and the Applicant Proposed Route (11 percent of ROI).

Active surface faults are present in Region 5 along HVDC Alternative Routes 5-B, 5-D, and 5-E, and expected ground motions from an earthquake would be low to moderate. Earthquake hazard transitions from low to moderate with eastward progression along the region, and seismicity impacts are expected to be minimal for all Region 5 alternatives. High liquefaction susceptibility is present in HVDC Alternative Route 5-D. The corresponding Applicant Proposed Route representative ROW is located in areas that have no high liquefaction susceptibility.

Region 5 is characterized by moderate susceptibility to landsliding and low incidence with the exception of the representative ROW for HVDC Alternative Route 5-D, for which landslides are low incidence and high susceptibility. Shallow bedrock is present along all routes (78 to 95 percent), and blasting may be required in these areas. There is also potential for direct impacts to paleontological resources in areas of shallow bedrock. Mineral resources and shale gas plays are traversed by both HVDC alternative routes and corresponding Applicant Proposed Project links.

3.6.1.6.3.2.1.6 Region 6

Table 3.6.1-18 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by the Region 6 HVDC alternative routes compared with the corresponding Applicant Proposed Route links. Because no active faults or karst formations occur, and landslides risks are low, these geologic hazards are not presented in Table 3.6.1-18.

From west to east within Region 6, the earthquake hazard transitions from low-moderate to moderate-high. HVDC Alternative Routes 6-C and 6-D, as well as the Applicant Proposed Route corresponding links, on the easternmost portion of Region 6 are located within moderate to high seismic hazard and are closer to the New Madrid Seismic Zone. Seismicity impacts are expected to be minimal for the four HVDC alternative routes and corresponding Applicant Proposed Route Links 2, 3, 4, 6, and 7. Most of the soils in both the HVDC alternative routes and Applicant Proposed Route representative ROWs have high liquefaction susceptibility.

Shallow bedrock is present along all routes in Region 6 (2 to 61 percent), and blasting may be required in these areas. There are only slight differences between the Region 6 alternative routes in terms of geologic hazards; and the HVDC alternative routes, compared to Applicant Proposed Route Links 2, 3, 4, 6, and 7, would have nearly the same impacts. There is also potential for direct impacts to paleontological resources in areas of shallow bedrock. HVDC Alternative Route 6-A traverses only one oil and gas well (listed as inactive).

3.6.1.6.3.2.1.7 Region 7

Table 3.6.1-19 summarizes relevant analysis considerations for geologic and mineral resources that could potentially impact or be impacted by construction of the HVDC transmission line in within the alternative routes in Region 7 Because no karst formations or mineral resources occur in Region 7, they are not presented in Table 3.6.1-19.

No active surface faults are present in Region 7, and expected ground motions from an earthquake would be moderate to high. Expected ground motion for HVDC Alternative Route-7A and the corresponding Applicant Proposed Route links is the highest of the HVDC alternative routes because it is closest to the New Madrid Seismic Zone. Susceptibility to liquefaction is high to very high for all HVDC alternative routes and the corresponding Applicant Proposed Route links.

High susceptibility areas for landslides are located in all of the HVDC alternative routes. Landslide incidence varies from low to moderate. Moderate incidence occurs along HVDC Alternative Routes 7-C and 7-D. The Applicant Proposed Route in Region 7 has somewhat less impact to high susceptibility areas for landslides than the HVDC alternative routes. Landslide hazards would be minimized in the same manner described for the Applicant Proposed Route. Shallow bedrock is present along routes HVDC Alternative Route 7-B, 7-C, and 7-D, with slightly more shallow bedrock present in the corresponding Applicant Proposed Route links for 7-B and 7-D. Blasting may be required in these areas. The HVDC alternative routes and corresponding Applicant Proposed Route Links 1, 3, 4, and 5 would have nearly the same overall impacts in terms of geologic hazards.

There is also potential for direct impacts to paleontological resources in areas of shallow bedrock during grading and excavation activities. Mineral resources were not identified within the representative ROWs in Region 7.

Table 3.6.1-16:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 4

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence (acres of karst)[3]	Liquefaction susceptibility (acres)[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock[6] (acres)	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 4-A	1,426	2 active faults; low ground motion potential (PGA of 2–3% of gravity)	Low incidence and moderate susceptibility (1,426 acres and 100%)	847 (59%)	69 (5%) (moderate)	572 acres (40%)	1,228 (86%)	Crosses more shallow bedrock and more karst formations; fewer potential shale gas deposits; and lower number of oil and gas wells.
Corresponding APR Links 3, 4, 5, 6	1,475	2 active faults; low ground motion potential	Low incidence and moderate susceptibility (1,202 acres and 81%)—less impact	415 (13%) —less impact	431(29%) (high); 139 (9%) (moderate)–greater impact due to high susceptibility areas	622 acres (42%), 4 oil/gas wells—greater impact	946 (64%) —less impact	NA
AR 4-B	1,920	2 active faults; low ground motion potential l (PGA of 2–3% of gravity)	Low incidence and moderate susceptibility (1,920 acres and 100%)	1,043 (54%)	No moderate or high susceptibility areas	948 acres (49%), 6 oil/gas wells	1,542 (80%)	Crosses more shallow bedrock and more karst formations and fewer potential shale gas deposits and is less susceptible to liquefaction.
Corresponding APR Links 2, 3, 4, 5, 6, 7, 8	1,988	2 active faults; low ground motion potential	Low incidence and moderate susceptibility (1,550 acres and 78%);—less impact	518 (17%) —less impact	405 (20%) (high); 163 (8%) (mod)—greater impact	1,032 acres (52%), 6 oil/gas wells—greater impact	1,334 (67%) —less impact	NA
AR 4-C	83	0 active faults; low ground motion potential l (PGA of 3% of gravity)	Low incidence and moderate susceptibility (83 acres and 100%)	83 (100%)	32 (39%) (high)	83 acres (100%)	83 (100%)	Crosses more shallow bedrock, more potential shale gas deposits, and more karst formations and is more susceptible to liquefaction.
Corresponding APR Link 5	53	0 active faults; low ground motion potential	Low incidence and moderate susceptibility (53 acres and 100%)	53 (100%) – less impact	2 (4%) (high)—less impact	53 acres (100%) —less impact	53 (100%) —less impact	NA

Table 3.6.1-16:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 4

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence (acres of karst)[3]	Liquefaction susceptibility (acres)[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock[6] (acres)	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 4-D	618	1 active faults; low ground motion potential (PGA of 3% of gravity)	Low incidence and moderate susceptibility (618 acres and 100%)	550 (89%)	4 (high) (<1%); 69 (11%) (mod)	618 acres (100%)	545 (88%)	Crosses fewer potential shale gas deposits and oil and gas wells and more shallow bedrock and is more susceptible to landslides and less susceptible to liquefaction.
Corresponding APR Links 4, 5, 6	619	1 active faults; low ground motion potential	Low incidence and moderate susceptibility (346 acres and 56%); —less impact	215 (70%)	340 (55%) (high); 139 (22%) (mod)—greater impact	619 acres (100%), 4 oil/gas wells—greater impact	286 (46%) —less impact	NA
AR 4-E	897	0 active faults; low ground motion potential (PGA of 3–4% of gravity)	Moderate susceptibility, and low incidence (267 acres and 30%)	No karst	96 (11%) (high)	897 acres (100%), 6 oil/gas wells	513 (57%)	Crosses fewer potential shale gas deposits, more oil and gas wells, and less shallow bedrock and is more susceptible to liquefaction and less susceptible to landslides.
Corresponding APR Links 8, 9	947	1 active faults; low ground motion potential - greater impact	Moderate susceptibility, and low incidence (906 acres and 96%)—greater impact	No karst	No moderate or high susceptibility areas)—less impact	947 acres (100%), 2 oil/gas wells - greater impact	550 (58%) —greater impact	NA

GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001)
3 Tobin and Weary (2004)
4 CUSEC (2008)
5 OCC (2013), AOGC (2014), USGS (2005b), EIA (2011a)
6 NRCS (2013)

Table 3.6.1-17:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 5

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence[3] (acres of karst)	Liquefaction[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock (acres)[6]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 5-A	308	0 active faults; low ground motion potential (PGA of 4–5% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	308 acres (100%), 2 oil/gas wells	256 (86%)	Crosses less shallow bedrock, and more oil and gas wells.
Corr. APR Links 1	300	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	300 acres (100%)	267 (89%)	NA
AR 5-B	1,732	1 active faults; low to moderate ground motion potential (PGA of 5–9% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	1,732 acres (100%), 4 oil/gas wells	1,591 (92%)	Crosses lower number of oil and gas wells, more shallow bedrock/restrictive layers, and more potential shale gas deposits and is slightly less susceptible to liquefaction.
Corr. APR Links 3, 4, 5, 6	1,641	Same as corresponding AR	Same as corresponding AR	No Karst	High (23 acres and 1%)	1,641 acres (100%), 10 oil/gas wells	1,519 (93%)	NA
AR 5-C	225	0 active faults; low to moderate ground motion potential (PGA of 10% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	225 acres (100%), 2 oil/gas wells	205 (91%)	Crosses more potential shale gas deposits; fewer oil and gas wells, and more shallow bedrock.
Corr. APR Links 6	109	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	109 acres (100%), 4 oil/gas wells	83 (76%)	NA
AR 5-D	530	1 active faults; low to moderate ground motion potential (PGA of 10% of gravity)	High susceptibility, Moderate incidence (153 acres and 29%), Low incidence (93 acres and 18%), Moderate susceptibility, Low incidence (284 acres and 54%)	389 (73%)	High (179 acres and 34%)	515 acres (97%)	416 (78%)	Crosses more land with a high susceptibility to landslides, more potential shale gas deposits, and more shallow bedrock.

Table 3.6.1-17:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 5

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Landslides[2]	Subsidence[3] (acres of karst)	Liquefaction[4]	Mineral Resources (shale gas plays acres, oil/gas wells)[5]	Shallow Bedrock (acres)[6]	Impact Comparison with Applicant Proposed Route Corresponding Links
Corr. APR Link 9	500	Same as corresponding AR	High susceptibility, Low incidence (112 acres and 22%), Moderate susceptibility, Low incidence (253 acres and 51%)	308 (62%)	Very low	375 acres (75%)	332 (66%)	NA
AR 5-E	885	1 active faults; low to moderate ground motion potential (PGA of 7–9% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	885 acres (100%), 4 oil/gas wells	837 (95%)	Crosses more potential shale gas deposits, less oil and gas wells, and more shallow bedrock.
Corr. APR Links 4, 5, 6	811	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	811 acres (100%), 8 oil/gas wells	766 (94%)	NA
AR 5-F	544	0 active faults; low to moderate ground motion potential (PGA of 8–9% of gravity)	Low incidence and moderate susceptibility	No Karst	Very low	544 acres (100%), 2 oil/gas wells	501 (92%)	Crosses more potential shale gas deposits, more oil and gas wells, and more shallow bedrock.
Corr. APR Links 5, 6	459	Same as corresponding AR	Same as corresponding AR	No Karst	Very low	459 acres (100%)	416 (91%)	NA

GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001)
3 Tobin and Weary (2004)
4 CUSEC (2008)
5 AOGC (2014), USGS (2005b) (metallic and non-metallic mineral resources), EIA (2011a)
6 NRCS (2013)

Table 3.6.1-18:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 6

Parameter	Representative ROW Impact Area (acres)	Seismicity[1]	Liquefaction[2]	Mineral Resources[3]	Shallow Bedrock[4] (acres)	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 6-A	396	0 active faults; low to moderate ground motion potential (PGA of 10 to 20% of gravity)	High (396 acres and 100%)	1 oil/gas well (inactive)	238 (60%)	Nearly the same impacts with less impact to shallow bedrock.
Corresponding APR Links 2,3,4	433	Same as AR 6-A	High (433 acres and 100%)	None—less impact	278 (64%)—greater impact	NA
AR 6-B	344	0 active faults; low to moderate ground motion potential (PGA of 10 to 15% of gravity)	High (344 acres and 100%)	None	209 (61%)	Nearly the same impacts with somewhat greater impact to shallow bedrock.
Corresponding APR Link 3	236	Same as AR 6-B	High (236 acres and 100%)	Same as AR 6-B	173 (73%)—less impact	NA
AR 6-C	566	0 active faults; moderate to high ground motion potential (PGA of 20 to 30% of gravity)	High (264 acres and 47%), Moderate (61 acres and 11%) Very High (241 acres and 43%)	None	262 (46%)	Nearly the same impacts with slightly less impact to soil liquefaction and shallow bedrock.
Corresponding APR Links 6,7	606	Same as AR 6-C	High (260 acres and 43%), Moderate (84 acres and 14%), Very High (262 acres and 43%)—greater impact	Same as AR 6-C	291 (48%)—greater impact	NA
AR 6-D	209	0 active faults; high ground motion potential (PGA of 30% of gravity)	Very high (209 acres and 100%)	None	4 (2%)	Nearly the same impacts.
Corresponding APR Link 7	224	Same as AR 6-D.	Very high (224 acres and 100%)	Same as AR 6-D	0 (0%)—less impact	

GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b);
2 CUSEC (2008)
3 AOGC (2014), USGS (2005b) (metallic and non-metallic mineral resources), EIA (2011a)
4 NRCS (2013)

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Table 3.6.1-19:
Geological and Mineral Resources within the 200-Foot Representative ROW—Region 7

Parameter	Impact Area (acres)	Seismicity[1]	Landslides[2]	Liquefaction[3]	Shallow Bedrock (acres)[4]	Impact Comparison with Applicant Proposed Route Corresponding Links
AR 7-A	1,052	0 active faults; moderate to high ground motion potential (PGA of 20 to 30% of gravity)	High susceptibility, low incidence (594 acres and 56%)	Very high (1,052 acres and 100%)	0 (0%)	Nearly the same impacts with somewhat more impact to potential landslide areas.
Corresponding APR Link 1	698	Same as AR 7-A.	High susceptibility, low incidence (414 acres and 59%)—less impact	Very high (698 acres and 100%)	0 (0%)	NA
AR 7-B	210	0 active faults; moderate to high ground motion potential (PGA of 20% of gravity)	High susceptibility, low incidence (39 acres and 19%)	High (165 acres and 79%); very high (45 acres and 21%)	13 (6%)	Nearly the same impacts with somewhat more impact to landslide and soil liquefaction areas; and less impact to shallow bedrock.
Corresponding APR Links 3,4	205	Same as AR 7-B	High susceptibility, low incidence (27 acres and 13%)—less impact	High (178 acres and 87%); very high (27 acres and 13%)—less impact	33 (16%)—greater impact	NA
AR 7-C	579	0 active faults; moderate ground motion potential (PGA of 15 to 20% of gravity)	High susceptibility, low incidence (39 acres and 7%)	High (416 acres and 72%), Very High (162 acres and 28%)	134 (23%)	Crosses more shallow bedrock, and is more susceptible to liquefaction and landslides. Slightly lower overall seismicity (PGA).
Corresponding APR Links 3,4,5	323	0 active faults; moderate ground motion potential (PGA of 20% of gravity) – slightly higher seismicity	High susceptibility, low incidence (27 acres and 8%); high susceptibility, moderate incidence (100 acres and 31%); low incidence (196 acres and 61%)—less impact	High (296 acres and 92%), very high (27 acres and 8%)—less impact	54 (17%)—less impact	NA
AR 7-D	160	0 active faults; moderate ground motion potential (PGA of 20% of gravity)	High susceptibility, moderate incidence (110 acres and 69%)	High (160 acres and 100%)	14 (9%)	Crosses less shallow bedrock, and is somewhat more susceptible to landslides.
Corresponding APR Links 4,5	157	Same as AR 7-D	High susceptibility, moderate incidence (100 acres and 64%)—less impact	High (157 acres and 100%)	35 (22%)—greater impact	NA

GIS Data Sources:
1 Garrity and Soller (2009), USGS (2008b)
2 USGS (2001)
3 CUSEC (2008)
4 NRCS (2013)

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3.6.1.6.3.2.2 Operations and Maintenance Impacts

Impacts to and from geologic hazards during operations and maintenance would be the same as described in 3.6.1.6.2 for the Applicant Proposed Route.

3.6.1.6.3.2.3 Decommissioning Impacts

Impacts to and from geologic hazards during decommissioning would be the same as described in 3.6.1.6.2 for the Applicant Proposed Route.

3.6.1.6.4 Best Management Practices

No BMPs are recommended because implementation of the EPMs and appropriate engineering design methods is anticipated to avoid and minimize impacts related to geologic hazards, paleontological resources, and mineral resources.

3.6.1.6.5 Unavoidable Adverse Impacts

Appropriate engineering design and adherence to applicable design standards would reduce the risk from geological hazards, but damage to Project components could occur if a rare, major geologic event such as a large magnitude earthquake or landslide occurred.

Despite EPMs and appropriate engineering design, scientifically valuable fossils may be disturbed and lost during construction activities. If this occurred, the small loss of fossil material would be offset to a degree by material that is recovered and preserved for scientific study purposes.

Mineral resources may exist directly underneath the route ROWs and/or converter station sites, in which case some resources could be less accessible for the life of the Project. The types of mineral resources that would be more affected are near-surface mineral material deposits (e.g., common sand, gravel, and stone). Oil and gas resources would be less affected because recovery of the resources would be possible, even with a minimum stand-off of 250 feet from the edge of the route ROWs and converter station sites using a vertically installed well, without the use of directional drilling. With directional drilling, such areas could be accessed at considerable distance from the Project.

3.6.1.6.6 Irreversible and Irretrievable Commitment of Resources

Because paleontological resources are nonrenewable, any impacts would render the resource disturbance irreversible and the integrity of the resource irretrievable. The short-term preclusion of access to some mineral resources would constitute an irreversible impact for the operational life of the Project.

3.6.1.6.7 Relationship between Local Short-term Uses and Long-term Productivity

No relationships exist between local short-term uses and long-term productivity for geological hazards. Short-term impacts associated with the exposure of any scientifically important fossils from Project activities would not adversely impact the long-term potential for discovery of potential fossil resources. Any short-term effects to access to mineral resources are not expected to cause long-term impairment to the productivity of mineral resources.

3.6.1.6.8 Impacts from Connected Actions

3.6.1.6.8.1 Wind Energy Generation

3.6.1.6.8.1.1 Construction Impacts

No impacts from seismic hazards, landslides, or soil liquefaction were identified, and no impacts to mineral resources are anticipated from construction activities in the WDZs. Subsidence from karst is a possible geologic hazard of concern within the WDZs. The approximate percentages of karst contained within the WDZs range from 0 to 87 percent. Appropriate engineering design and proper placement of wind farm infrastructure would typically be implemented to minimize the risks associated with constructing wind farms across karst. However, complete avoidance of karst is not possible, and the risk to wind farm components from subsidence would still exist. Additionally, the excavation and drilling required for the foundations of the wind turbines could create new preferential flow pathways, which could increase the risk of introducing constituents into the karst system that could eventually impact groundwater quality.

Although no known fossil bed sites were identified in the wind energy generation ROI, grading and excavation activities have the potential to cause direct impacts to paleontological resources. These impacts could occur if fossils are at or near the ground surface in rock outcrops and/or areas of shallow bedrock. Grading activities would typically be limited to the minimum amount needed to create safe working surfaces. Foundation excavations would typically be made using power drill or augers; blasting would typically only be used where necessary and in accordance with wind developer's Blasting Plan. Typically, project personnel would be trained in the practices, techniques, and protocols required by federal and state regulations and applicable permits. Training of personnel if required would increase the likelihood that any unique fossils exposed during an excavation would be identified and the necessary steps taken to preserve them.

Wind turbines and other infrastructure would be dispersed within the wind farms, such that alternative placement of drilling equipment would be possible, if required, and access to oil, gas, and mineral resources should not be greatly diminished. Additionally, turbines and associated facilities are often micro-sited to avoid sensitive land uses, or as preferred by the participating landowners in lease provisions. Impacts on mineral resources extraction during construction are anticipated to be minor.

3.6.1.6.8.1.2 Operations and Maintenance Impacts

During operations and maintenance, impacts to wind farm facilities from seismicity are not anticipated, because the area is located in an area of low seismic risk, so soil liquefaction risk is also expected to be low. Wind farm facilities would not likely be affected by karst because the engineering design and placement of facilities to minimize risks from karst would typically be put in-place during construction. However, due to the prevalence of karst in the area the risk for subsidence does exist. Impacts to mineral resource accessibility would not be expected if protective measures described for the construction phase were put in place; and the locations of the facilities would be designed to avoid mineral resources to the extent possible. Blasting would not occur and other soil disturbing activities would be negligible, so no impacts to fossils would be expected.

3.6.1.6.8.1.3 Decommissioning Impacts

Any risks to the wind farm facilities associated with identified geologic hazards would be removed when the facilities were decommissioned. Some ground disturbance would occur from the use of machinery such as bulldozers to demolish facility buildings or cranes used to deconstruct the wind turbines. However, ground disturbance would be limited to the near surface in previously disturbed areas. Decommissioning would not impact karst because protective measures used during construction would also be applied during decommissioning and the amount of ground disturbance associated with decommissioning would be less than during construction. Access to oil and gas or mineral resources would no longer be potentially affected by the presence of the facilities.

3.6.1.6.8.2 Optima Substation

Seismicity characteristics for the future Optima substation are low and similar to those described in Region 1. The area is within karst; and shallow bedrock is present in 15 acres (9 percent of the 160-acre siting area). Mineral resources are not present. Potential effects from karst associated with subsidence could be avoided or minimized through appropriate engineering design. Potential effects to fossil resources would be avoided or minimized through limiting the area of disturbance during construction activities.

3.6.1.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

Like the Project, the required TVA upgrades would not be expected to increase geologic hazards, except potentially landslide hazards. Depending on the location of the new transmission line, the potential to impact landslide risks could occur during construction. Impacts from upgrades to existing transmission lines and substations are expected to minimal or non-existent.

Grading and excavation activities have the potential to uncover and impact paleontological resources. If paleontological resources are similar to those analyzed for the Project, the potential associated with the TVA upgrades would be expected to be minimal. Some impacts to paleontological resources could occur during construction of the new 500kV transmission line.

The required TVA upgrades would be unlikely to affect mineral resources because they would not affect new areas of potential mineral resources. Effects could occur if construction of the new transmission line impeded access to mineral resources.

3.6.1.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, the Project would not be constructed and geology, paleontology, and mineral resources would not be impacted. Areas of geologic hazard would not be impacted, nor would these hazards impact Project infrastructure.

3.6.2 Soils

3.6.2.1 Regulatory Background

Soil resources are managed through a broad set of regulations, guidelines, and formal planning processes. These controls and directions are administered through federal, state, or local units of government. Through state and local agency offices, the NRCS administers soil conservation programs on private lands. In addition, the NRCS inventories Prime and Unique Farmlands, as identified in 7 CFR Part 657 and further described in Table 3.6.2-1. Prime Farmland in the ROI is shown on Figure 3.6-7 (located in Appendix A).

Table 3.6.2-1:
Federal and State Laws and Regulations Associated with Soils Resources

Statute/Regulation	Key Elements
Federal	
FPPA (7 CFR Part 657)	The FPPA authorizes the USDA to develop criteria for identifying the effects of federal programs on the direct or indirect conversion of farmland to nonagricultural uses. For the purposes of the law, federal programs include construction projects sponsored or financed in whole or part by the federal government and the management of federal lands. Federal agencies are directed to (1) use the developed criteria, (2) identify and take into account the adverse effects of federal programs on the preservation of farmland, (3) consider appropriate alternative actions that could minimize potential adverse effects to farmland, and (4) ensure that such federal programs, to the extent practicable, are compatible with state and local units of government, as well as private programs and policies, so that farmland is protected (NRCS 2014a). Farmland protected by the FPPA is either (1) prime or unique farmland, which is not already committed to urban development or water storage, or (2) other farmland, which is of statewide or local importance as determined by the appropriate state or local governmental agency with the concurrence of the Secretary of Agriculture. Farmland subject to FPPA is not required to be currently used for cropland. Farmland can be forestland, pastureland, cropland, or other land (NRCS 2014a). The county soil survey provided by the NRCS determines which soils are protected. When a federal agency is involved in a project, the NRCS completes a Farmland Conversion Impact Rating worksheet, Form AD-1006. The purpose of the FPPA is to minimize the impact that federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. However, the FPPA does not authorize the federal government to regulate the use of private or nonfederal land or in any way affect the property rights of owners. As such, the FPPA does not regulate farmland, but is a mechanism for the reporting and documentation of farmland conversion activities and is used to alert decision makers in cases of farmland conversion concerns.
National Pollutant Discharge Elimination System (NPDES) stormwater program	Soil erosion is governed by regulations contained in EPA's stormwater management regulations, derived as part of the Clean Water Act. Under the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) stormwater program requires operators of construction sites 1 acre or larger (including smaller sites that are part of a larger common plan of development) to obtain authorization to discharge stormwater under an NPDES construction stormwater permit. The development and implementation of SWPPPs is the focus of NPDES stormwater permits for regulated construction activities. Stormwater permits would be required for the Project from federal, state, and local agencies based on specific jurisdictional authority.

3.6.2.2 Data Sources

Soil information and data from the NRCS Soil Survey Geographic (SSURGO) database (GIS Data Source: NRCS 2013) were obtained to determine soil characteristics and potential soil hazards. General regional soil information was obtained from the NRCS (GIS Data Source: Jin et al. 2013) Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin (GIS Data Source: NRCS 2006). Soil information for prime farmlands and for farmland soils of state and local importance was obtained from the SSURGO database (GIS Data Source: NRCS 2013). It should be noted that soil information is not available for unique farmland in the SSURGO database and that coordination with state agencies is ongoing to obtain this information as further discussed in Section 3.2. Information and data regarding potential soil contamination are based on available information from regulatory databases including EPA's Facility Registry Service (FRS) Database (GIS Data Source: EPA 2014b).

NRCS soil surveys (typically one per county) are mapped independently, and soil scientists that map the survey areas sometimes apply the available soil categories differently. For example, two soil map units on either side of a county boundary may be mapped with slightly different prime farmland categories. Therefore, slight variations in the consistency of the impacts to designated farmland across counties could occur. Such variations are not expected to be significant in terms of the overall analysis.

The description of each region below was derived from the broad landform characteristic areas that NRCS denotes as major land resource areas (MLRAs). The more detailed discussion of soils in Regions 1 through 7 follow the NRCS soil taxonomy/classification system that includes six ranking categories (in descending rank): order, suborder, great group, subgroup, family, and series. The soils descriptions are presented broadly by soil order to allow for a meaningful characterization of the ROI without describing the more than 3,000 individual soils series that exist in the ROI. Exceptions have been made for specific convertor station site areas where more detailed information is provided.

Throughout this section, characteristics that may indicate potential impacts or differentiate between the Applicant Proposed Project and DOE Alternatives are presented in tables, while other factors are omitted.

3.6.2.3 Region of Influence

3.6.2.3.1 Region of Influence for the Project

The ROI for soils is the same as the description provided in Section 3.1.1.

3.6.2.3.2 Region of Influence for Connected Actions

The ROI for soils for wind energy development, the future Optima substation, and TVA upgrades is described in Section 3.1.1.

3.6.2.4 Affected Environment

Soil characteristics across Regions 1 through 7 are influenced by the semi-arid conditions in the west and humid conditions in the east. Landforms in Oklahoma include rolling hills, plateaus, and ridgetops dissected by drainages and river valleys. Landforms in Arkansas include large areas of the eroded mountainous areas of the Ozarks. Landforms in eastern Arkansas and Tennessee (Region 7) are dominated by loess uplands and floodplain areas of the Mississippi River Valley. Figure 3.6-8 in Appendix A shows the MLRAs traversed by the Project.

3.6.2.4.1 Designated Farmland

Designated farmland within the ROI includes NRCS categories including the "prime farmland" categories, and the category of "state and local importance." No designated "unique farmland" is mapped in the Project ROI. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion as determined by the USDA. Prime farmland can include land that possesses these characteristics but is being used currently to produce livestock and timber. Urbanized land and open water are excluded from prime farmland. Prime farmland typically contains few or no rocks, is permeable to water and air, is not excessively erodible or saturated with water for long periods, and is not subject to frequent, prolonged flooding during the growing season. Soils that do not meet the above criteria may be considered prime farmland if the limiting factor is mitigated (e.g., using artificial drainage or irrigation). Farmland of state and local Importance is identified by the associated state and local conservation agencies and officials.

3.6.2.4.2 Soil Limitations

The affected environment section provides a general baseline for the soil limitations parameters to set the stage for the more detailed discussion in the impacts section. Soil limitations of concern are described in greater detail in Section 3.6.2.6 of the impacts analysis. Important soil limitation characteristics used to describe the affected environment include the following:

3.6.2.4.2.1.1 Hydric Soils

Hydric soils are defined as "soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (59 FR 16835, July 13, 1994). Soils that are artificially drained or protected from flooding (e.g., by levees) are considered hydric if the soil in its undisturbed state would meet the definition of a hydric soil. Hydric soils are typically associated with jurisdictional wetlands, which must meet three required criteria: hydric soils, wetland hydrology, and hydrophytic vegetation, except in "difficult wetland situations" where not all criteria are evident. These situations are defined in the regional interim supplements to the USACE's Wetland Delineation Manual (Environmental Laboratory 1987).

3.6.2.4.2.1.2 Erosion Potential

Erosion is a continuing natural process that can be accelerated by human disturbances. Factors that influence soil erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. Wind erosion processes are less affected by slope angles but highly influenced by wind intensity.

Soils with a severe water erosion potential indicate that erosion is very likely and that erosion control measures are advisable. Very severe water erosion potential indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

3.6.2.4.2.1.3 Compaction Potential

Soil compaction is the process by which soil pore air space is reduced in size because of physical pressure exerted on the soil surface. Compaction results in soil conditions that reduce infiltration, permeability, and gaseous and nutrient exchange rates of the soil. Physical resistance to root growth can occur with high soil bulk densities. Soil compaction changes the soil structure by reducing the porosity and increasing the bearing strength of the soil. As a result, the ability to receive water is reduced, leading to an overall reduction in the moisture-holding capacity of the soil. The degree of compaction depends on the moisture content at the time of compaction and soil texture. Compaction decreases infiltration and thus increases runoff and the hazard of water erosion. Fine-textured soils with poor internal drainage are the most susceptible to compaction. Sandy loam, loam, and sandy clay loam soils compact more easily than silt, silt loam, silty clay loam, silty clay, or clay soils.

Soil compaction and displacement reduces water infiltration and often diverts lateral movement of the water within the soil. These conditions not only lead to increased erosion and sedimentation potential but could contribute to higher stormwater runoff from normal peak flows. The movement of heavy construction equipment, soil mixing or displacement from grading/excavation activities, or rutting from equipment or vehicle traffic could result in soil compaction and damage to soil structure.

3.6.2.4.2.1.4 Corrosion

Soils that are rated as having a risk of corrosion for "uncoated steel" or concrete are directly related to the susceptibility of uncoated steel or concrete to corrode when in contact with the soil (GIS Data Source: NRCS 2013). Corrosion is generally defined as the soil property that would create conditions for potential damage to these construction materials. Soil properties contributing to risk of corrosion to uncoated steel include high acidity, texture, existence of soluble salts, and a pH of 4.0 or less. Soil properties contributing to risk of corrosion to concrete include high acidity, texture, existence of soluble salts, and the presence of gypsum or other sulfate minerals.

3.6.2.4.2.1.5 Restrictive Layer

A "restrictive layer" is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provides an unfavorable root environment (GIS Data Source: NRCS 2013). Examples are bedrock, cemented layers, dense layers, and frozen layers. Soils that are rated as having a restrictive layer are shallow soils that have a lithic, paralithic, or other restrictive soil layer within 60 inches of the soil surface. A shallow restrictive layer can affect land development and is also is indicative of potential reclamation concerns. The restrictive layer for the ROI is shown on Figure 3.6-9 (located in Appendix A).

3.6.2.4.2.1.6 Steep Slopes

Slopes were evaluated for slopes from 15 to 30 percent and for slopes greater than 30 percent. These slope ranges were selected because the operation of rubber-tired equipment becomes hazardous when the slope approaches and exceeds 30 percent. In addition, soil erosion concerns are generally greater as slopes become steeper. The two ranges provide a broad indication of locations that might present construction and operational limitations related to ground vehicle maneuverability, development limitations, and potential erosion concerns.

3.6.2.4.2.1.7 Large Stones

Soils with a high percentage of cobbles and stones in the soil profile can present significant problems with surface reclamation because they hold less available water for plant growth and generally require broadcast seeding methods.

3.6.2.4.2.2 Soil Contamination

Areas of potential soil contamination are identified within the ROI based on searches of the EPA FRS Database (GIS Data Source: EPA 2014b). The database integrates information from a variety of sources about facilities that are required to report activity about hazardous waste, toxic and air releases, Superfund sites, and water discharge permits to a state or federal system. Most of the EPA tracked sites are indicative of inventoried sites that have permits or are otherwise under regulatory authority, but do not raise a red flag in terms of existing contamination issues. The affected environment evaluation provides a broad evaluation and identifies sites that might raise such a concern. More detailed evaluation of individual sites that might raise contamination issues for the Project is included in the impacts section. EPA Sites in the ROI are shown on Figure 3.6-10 (located in Appendix A). The FRS database categories identified in the ROI include the following (which are identified by region in Section 3.6.2.5):

- LUST–ARRA—The Leaking Underground Storage Tank (LUST)–American Recovery and Reinvestment Act (ARRA) system collects data on LUST releases that are tracked by ARRA performance measures or for which

ARRA funds are being spent. Data are collected for each release, including identification, performance measures, reference information, and location information.

- TCEQ—Texas Commission on Environmental Quality (TCEQ) Alternative Capacity Requirement (ACR)—The TCEQ ACR is a computer application that allows the TCEQ to use a single centralized area to record common information, such as the company names, addresses, and telephone numbers of entities the TCEQ regulates. It also contains additional information about permits, registrations, authorizations, etc. including their status.
- RCRAInfo—Hazardous waste information is contained in the Resource Conservation and Recovery Act Information (RCRAInfo), a national program management and inventory system about hazardous waste handlers. In general, all generators, transporters, treaters, storers, and disposers of hazardous waste are required to provide information about their activities to state environmental agencies. This regulation is governed by the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984.
- NPDES—The EPA's Office of Wastewater Management leads and manages the NPDES permit program in partnership with EPA Regional Offices, states, tribes, and other stakeholders.
- Permit Data Summary (PDS)—PDS is an Arkansas system maintaining data on air quality, mining, tires, solid waste, tank, water and hazardous waste, as well as inspections, invoicing and complaints.
- BR—The EPA Hazardous Waste Report (Biennial Report or "BR") collects data on the generation, management, and minimization of hazardous waste.
- eGRID—The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States.
- EIA—U.S. Energy Information Administration (EIA)-860—The survey Form EIA-860 collects generator-level specific information about existing and planned generators and associated environmental equipment at electric power plants with 1MW or greater of combined nameplate capacity.
- TRI—The Toxics Release Inventory (TRI) tracks the management of more than 650 toxic chemicals that pose a threat to human health and the environment. U.S. facilities in certain industry sectors that manufacture, process, or otherwise use these chemicals in amounts above established levels must report how each chemical is managed through recycling, energy recovery, treatment, and releases to the environment. A "release" of a chemical means that it is emitted to the air or water, or placed in some type of land disposal.
- ICIS—The Integrated Compliance Information System (ICIS) is a web-based system that provides information for the Federal Enforcement and Compliance and the NPDES programs.
- CERCLA—EPA administers the Superfund program in cooperation with individual states and tribal governments. The Comprehensive Environmental Response, Compensation, and Liability Information System database provides information regarding these Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or otherwise named Superfund sites.
- NCDB—National Compliance Data Base (NCDB) supports implementation of the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Control Act. The system tracks inspections in regions and states with cooperative agreements, enforcement actions, and settlements.
- SSTS—Section Seven Tracking System (SSTS) tracks the registration of all pesticide-producing establishments and tracks annually the types and amounts of pesticides, active ingredients, and related devices that are produced, sold, or distributed.

3.6.2.5 Regional Description

3.6.2.5.1 Region 1

Southern High Plains, Northern Part MLRA

The western portion of the ROI in Region 1, including the Oklahoma Converter Station Siting Area, Oklahoma AC Transmission Interconnection Siting Area, and AC collection system routes, is located in the Southern High Plains, Northern Part MLRA. This area is characterized by open plains on an elevated plateau cut by draws with moderate to very steep slopes (GIS Data Source: NRCS 2006). The narrow floodplains generally trend from southwest to northeast. Interspersed playa basins are also present in the MLRA and can range from 5 acres to more than 100 acres. Topographical relief is generally nearly level to very gently sloping and elevations increase gradually from southeast to northeast. Almost all of the MLRA is agricultural; nearly one-fifth of the area is irrigated.

Soil resource concerns in the MLRA are wind erosion, water erosion, maintenance of the content of soil organic matter and productivity, and management of soil moisture. Conservation practices on cropland generally include systems of crop residue management (especially no-till systems that reduce the need for tillage), cover crops, windbreaks, vegetative wind barriers, wind stripcropping, and nutrient management. The dominant conservation practice on rangeland is prescribed grazing.

Alfisols and mollisols are the predominant soil orders in the MLRA. These soils are characterized by a mesic soil temperature regime, an ustic soil moisture regime, and mixed minerology. The mesic soil temperature regime has mean annual soil temperatures of 8 degrees centigrade (°C) or more, but less than 15°C, and the difference between mean summer and mean winter soil temperatures is greater than 5°C at 50 centimeters (cm) below the surface (Plant and Soil Sciences eLibrary 2014). The ustic soil moisture regime indicates a semiarid climate. The soils are generally very deep, well drained, and loamy. These soils are present as loess and loamy material on plains, sandy eolian material on sandhills, and as loess on ridges and side slopes adjacent to drainage ways. Soils in the area are also present as lacustrine deposits on playa floors.

Southern High Plains, Breaks MLRA

The central portion of ROI in Region 1 is located in the Southern High Plains, Breaks MLRA. The MLRA is characterized by very steep escarpments, very gently sloping to moderately sloping plains, strongly sloping hills and ridges, and integrated drainage networks along the Canadian and Beaver rivers (GIS Data Source: NRCS 2006). The landscape has undulating to hilly topography and well developed, dendritic drainage systems. Elevations increase in the MLRA from the southeast to northwest.

Soil resource concerns in the MLRA are wind erosion, water erosion, maintenance of the content of soil organic matter and productivity of the soils, and management of soil moisture. Soil conservation practices on cropland generally include systems of crop residue management (especially no-till systems that reduce the need for tillage), cover crops, windbreaks, vegetative wind barriers, wind stripcropping, and nutrient management. The most important conservation practice on rangeland is prescribed grazing.

Alfisols, inceptisols, and mollisols are the predominant soil orders in the MLRA. These soils are characterized by a thermic soil temperature regime, an ustic soil moisture regime, and mixed or carbonatic mineralogy (GIS Data Source: NRCS 2006). The soils are shallow to very deep, well drained, and generally loamy or sandy. The thermic soil temperature regime has mean annual soil temperatures of 15°C or more, but less than 22°C; and a difference between mean summer and mean winter soil temperatures of greater than 5°C at 50 cm below the surface (Plant and Soil Sciences eLibrary 2014). The soils are present as loamy sediments, old alluvium, and weathered caliche on plains and loamy material on stream terraces. Soils are also present in alluvium on floodplains, in mixed alluvium and colluvium on backslopes, and along footslopes on escarpments and hillslopes. Area soils also form in sandy and gravelly old alluvium on knobs and hillslopes, in older loamy alluvium on hillslopes, and in coarse-textured sediments on floodplains. Weathered caliche soils are found on hills, ridges, and escarpments, and in wind-reworked sandy alluvium on dunes.

Central Rolling Red Plains, Eastern Part MLRA

The eastern portion of the ROI in Region 1 is located in the Central Rolling Red Plains, Eastern Part MLRA. This area is characterized by smooth to rolling hills and valleys that are moderately dissected. The rolling plains contain prominent ridges and valleys, some local areas of badlands, and numerous stream terraces. Elevations in the area are around 2,000 feet in Oklahoma.

Soil resources concerns include water erosion and conservation of soil moisture on cultivated soils and on overgrazed rangeland. Conservation practices on cropland generally include contour farming and crop residue management. Soil conservation practices on rangeland generally include proper grazing use, fencing, and development of watering facilities (GIS Data Source: NRCS 2006).

Alfisols, inceptisols, and mollisols are the predominant soil orders in the MLRA (GIS Data Source: NRCS 2006). These soils are characterized by a thermic soil temperature regime, an ustic soil moisture regime, and mixed or smectitic mineralogy (i.e., involving the family of clays that swell when immersed in water). The soils are generally moderately deep to very deep, are well drained and moderately well drained, and loamy or clayey. Soils are present as bedrock residuum on hills and ridges, loamy alluvium on stream terraces, and in mixed alluvium and colluvium on hills and stream terraces and in valleys. Soils are also present in sandy eolian deposits on dunes adjacent to the major rivers.

3.6.2.5.1.1 Designated Farmland

The percentage of designated farmland within the ROI of Region 1 is provided in Table 3.6.2-2.

Table 3.6.2-2:
Designated Farmland in Region 1 (Percentage of ROI)

Project Component	Total Acres within ROI	Prime Farmland (%)	Prime Farmland if Protected[1] (%)	Total Designated Farmland[2] (%)
Oklahoma Convertor Station Siting Area	626	0	0	0
Oklahoma AC Interconnection	871	8	0	8
AC Collection System	597,006	42	0	42
E-1	39,340	19	0	19
E-2	52,982	49	0	49
E-3	53,520	43	0	43
NE-1	40,359	53	0	53
NE-2	35,204	37	0	37
NW-1	68,166	49	0	49
NW-2	73,897	52	0	52

Table 3.6.2-2:
Designated Farmland in Region 1 (Percentage of ROI)

Project Component	Total Acres within ROI	Prime Farmland (%)	Prime Farmland if Protected[1] (%)	Total Designated Farmland[2] (%)
SE-1	53,085	48	<1	48
SE-2	18,926	57	0	57
SE-3	64,513	55	0	55
SW-1	19,142	11	0	11
SW-2	49,362	11	0	11
W-1	28,510	35	0	36
AR 1-A	15,036	27	0	27
AR 1-B	6,363	46	0	46
AR 1-C	6,377	54	0	54
AR 1-D	4,097	40	0	40
APR	14,143	50	0	50

GIS Data Source: NRCS (2013)
1 Prime farmland if protected from flooding or not frequently flooded during the growing season (NRCS 2013).
2 Total designated farmland categories that are present ("prime farmland" and "prime farmland if protected" are the only categories present in the Region 1 ROI).

3.6.2.5.1.2 Soil Limitations

Existing soil hazards within the ROI in Region 1 are summarized in Table 3.6.2-3 by Project component.

Table 3.6.2-3:
Soil Limitations in Region 1 (Percentage of ROI)

Project Component	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Hydric Soils[5]	Restrictive Layer[6]	15 to 30 Percent Slopes	>30 Percent Slopes
Oklahoma Convertor Station Siting Area	100	100	0	0	0	42	0	0
Oklahoma AC Interconnection	100	92	0	0	0	39	0	0
AC Collection System	93	56	0	24	<1	9	<1	<1
E-1	95	80	0	11	<1	18	<1	0
E-2	99	49	0	26	0	7	0	0
E-3	97	53	0	12	0	12	0	0
NE-1	95	47	0	6	1	9	0	0
NE-2	96	63	0	2	<1	15	0	0
NW-1	95	51	0	27	<1	6	0	0
NW-2	88	48	0	30	<1	5	0	0
SE-1	89	48	0	46	0	8	1	0
SE-2	93	39	0	54	0	10	4	0

Table 3.6.2-3:
Soil Limitations in Region 1 (Percentage of ROI)

Project Component	High Compaction Potential [1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential [3]	Corrosion Potential[4]	Hydric Soils[5]	Restrictive Layer [6]	15 to 30 Percent Slopes	>30 Percent Slopes
SE-3	99	43	0	44	0	6	0	0
SW-1	77	73	0	7	<1	10	4	0
SW-2	89	87	0	20	<1	12	6	<1
W-1	92	65	0	7	<1	9	0	0
AR 1-A	90	69	<1	8	0	19	5	0
AR 1-B	98	51	0	12	0	8	0	0
AR 1-C	99	46	0	13	0	5	0	0
AR 1-D	94	74	<1	26	0	6	<1	0
APR	91	51	<1	26	0	12	2	0

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO High steel or concrete potential.
5 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
6 Bedrock < 60 inches from ground surface.

3.6.2.5.1.3 Soil Contamination

No areas of potential soil contamination were identified within the most Project components based on EPA FRS database information (GIS Data Source: EPA 2014b). Eleven facilities/sites were identified in the AC collection system routes, including two LUST–ARRA sites, two NPDES sites, one RCRAInfo site, and six TCEQ ACR sites. The NPDES and RCRAInfo sites are indicative of permits being granted for the discharge of stormwater and generation, and handling or transport of hazardous substances. The TCEQ ACR sites indicate entities under TCEQ regulation such as for permits, registrations, and other authorizations. The LUST-ARRA sites indicate identified leaking underground storage tank sites that are under regulatory oversight for cleanup and closure activities. The presence of these sites on the database are simply indicative of a records inventory of such regulated sites and do not raise a concern at this time in regards to potential areas of soil contamination.

3.6.2.5.2 Region 2

Central Rolling Red Plains, Eastern Part MLRA

The western portion of the ROI in Region 2 is located in the Central Rolling Red Plains, Eastern Part MLRA, and the predominant soils orders are alfisols, inceptisols, and mollisols. These are described above under Region 1.

Central Rolling Red Prairies MLRA

The eastern portion of the ROI in Region 2 is in the Central Rolling Red Prairies MLRA. The area is characterized by dark red Permian rocks that are exposed dominantly on gently sloping plains dissected by rivers flowing from northwest to southeast. Elevation ranges from about 850 to 1,500 feet.

Agricultural uses dominate the area. Soil resource concerns on cropland include water erosion, surface compaction, conservation of soil moisture, and maintenance of the content of organic matter in the soils. Soil conservation practices on cropland generally include high residue crops in the cropping system; systems of crop residue management, such as no-till and strip-till; conservation crop rotations; and nutrient management. Conservation practices on grassland generally include brush management and proper grazing use.

Mollisols are the predominant soil order in the MLRA. Mollisols have a thermic soil temperature regime, an ustic soil moisture regime, and mixed, siliceous, or smectitic mineralogy. These soils generally are shallow to very deep, are well drained, and generally are loamy or clayey (GIS Data Source: NRCS 2006). The soils are present in clayey and loamy alluvium of Pleistocene age on plains, in Permian sandstone residuum on ridges and hillslopes, in Permian shale residuum on hillslopes, and in Holocene alluvium on floodplains.

3.6.2.5.2.1 Designated Farmland

The percentage of designated farmland within the ROI is provided in Table 3.6.2-4.

Table 3.6.2-4:
Designated Farmland in Region 2 (Percentage of ROI)

Project Component	Total Acres in ROI	Prime Farmland (%)	Total Designated Farmland (%)[1]
AR 2-A	6,992	25	25
AR 2-B	3,631	48	48
APR	12,932	22	22

GIS Data Source: NRCS (2013)
1 Total designated farmland categories that are present (“prime farmland” is the only category contained in the Region 2 ROI).

3.6.2.5.2.2 Soil Limitations

Existing soil limitations within Region 2 are summarized in Table 3.6.2-5 by Project component.

Table 3.6.2-5:
Soil Limitations in Region 2 (Percentage of ROI)

Project Component	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential [3]	Corrosion Potential[4]	Restrictive Layer[5]	15 to 30 Percent Slopes
AR 2-A	63	78	15	26	39	9
AR 2-B	81	38	12	29	41	<1
APR	40	74	8	16	18	4

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO High Concrete or Steel Corrosion Potential.
5 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.2.3 Soil Contamination

No areas of potential soil contamination were identified within the Region 2 ROI based on EPA FRS database information.

3.6.2.5.3 Region 3

Central Rolling Red Prairies MLRA

The ROI in western Region 3 crosses two portions of the Central Rolling Red Prairies MLRA, and mollisols is the dominant soil order. These are described above under Region 2.

North Cross Timbers MLRA

The ROI in west-central Region 3 crosses two portions of the North Cross Timbers MLRA. This area is characterized by rolling to hilly uplands with hilltop summits that are nearly level to strongly rolling and divides that are narrow to moderately broad. Stream valleys in the MLRA are narrow and have steep gradients, and bedrock outcrops occur on both hilltops and hillsides (GIS Data Source: NRCS 2006). Elevation ranges from 985 to 1,300 feet. Large valleys can be 165 feet or more below the adjacent uplands.

Soil resource concerns are water erosion, surface compaction, moisture conservation, and conservation of organic matter. Soil conservation practices on cropland generally include terraces, grassed waterways, nutrient management, grade-control structures, and conservation tillage. Conservation practices on rangeland generally include brush management, fencing, nutrient management, proper grazing, and range planting.

Alfisols, entisols, mollisols, and inceptisols are the predominant soil orders in the MLRA. The soils have a thermic soil temperature regime, an ustic or udic soil moisture regime, and mixed, siliceous, or smectitic mineralogy. Udic soil moisture is characteristic of a humid or subhumid climate (Plant and Soil Sciences eLibrary 2014). Soils are generally shallow to very deep, somewhat excessively drained to somewhat poorly drained and loamy or clayey. Area soils are present in alluvium on stream terraces, in bedrock residuum on hills, in colluvium and/or bedrock residuum on footslopes, and in alluvium on floodplains (GIS Data Source: NRCS 2006).

Cherokee Prairies MLRA

The ROI in central Region 3 crosses two portions of the Cherokee Prairies MLRA. The area is characterized by gently sloping to rolling dissected plains with elevations ranging from 330 to 1,310 feet. Even though the area is thoroughly dissected, major valleys generally are less than 8 feet below the adjacent uplands (GIS Data Source: NRCS 2006).

Soil resource concerns on cropland are water erosion, maintenance of the content of organic matter in soils, surface compaction, and low pH in the soils. Soil conservation practices on cropland generally include high residue crops in the cropping system, systems of crop residue management (such as no-till, strip-till, and mulch-till systems), a combination of gradient terraces and grassed waterways, contour farming, conservation crop rotations, and nutrient management. Conservation practices on rangeland generally include prescribed grazing and brush management.

Mollisols and alfisols are the predominant soil orders in the MLRA. The soils have a thermic soil temperature regime, an aquic or udic soil moisture regime, and mixed or smectitic mineralogy. The aquic soil moisture regime indicates soils that are saturated with water long enough to cause oxygen depletion. The soils generally are moderately deep to very deep, well-drained to poorly drained, and loamy or clayey. Soils in the area are present in alluvium on flood plains, in bedrock residuum on uplands, and in colluvium mixed with bedrock residuum. Soils are also present in old alluvium on plains and in alluvium on flood plains and stream terraces.

Arkansas Valley and Ridges, Western Part MLRA

The ROI in east-central Region 3 also crosses the Arkansas Valley and Ridges, Western Part MLRA. The topography of the area is characterized by long, narrow sandstone-capped ridges that trend northeastward. The ridges are dissected by valleys cut by streams at right angles to the ridges; the valleys and scarp areas generally are cut into less resistant shale units (GIS Data Source: NRCS 2006). Elevation ranges from 550 feet to 1,500 feet.

Strip-mining of coal is common throughout the area and has affected soil resources. Stabilizing strip-mine spoil and reclaiming mined areas are major soil management concerns; and efforts to maintain pasture and forest productivity are ongoing (GIS Data Source: NRCS 2006).

Udalfs or udepts soils are predominant in the MLRA. These soils have a thermic soil temperature regime, a udic soil moisture regime, and mixed or siliceous mineralogy. The soils include moderately deep soils and are gently sloping to steep, formed on ridgetops, shoulder slopes, and side slopes. Other soils in the area are very deep, gently sloping to sloping, and are formed on the side slopes of valleys. Deep, gently sloping to steep soils are formed on side slopes and footslopes; and shallow, sloping to steep soils are formed on narrow ridgetops and upper shoulder slopes. Very deep, gently sloping to steep soils formed on terraces along streams. Nearly level to sloping soils formed along floodplains throughout the area (GIS Data Source: NRCS 2006).

Boston Mountains MLRA

The eastern end of the ROI in Region 3 crosses the Boston Mountains MLRA. This MLRA marks the southern extent of the Ozarks and is an old plateau that has been deeply eroded. Ridgetops are narrow and rolling and valley walls are steep. Elevation ranges from 660 feet on the lowest valley floors to 2,625 feet on the highest ridge crests.

Soil resource concerns in this area are gully and streambank erosion and soil contaminants from applications of animal waste. Soil conservation practices on cropland include critical area planting, protection of streambanks and shorelines, riparian forest buffers, forage harvest management, soil nutrient management, waste utilization, brush management, grade-stabilization structures, and prescribed grazing (GIS Data Source: NRCS 2006).

Ultisols and inceptisols are the predominant soil orders in the MLRA. The soils dominantly have a thermic soil temperature regime, a udic soil moisture regime, and mixed or siliceous mineralogy. The soils are shallow to very deep, generally well drained, and loamy. Soils in the area are formed in residuum on hills, plateaus, and mountains, in alluvium or colluvium over residuum, and in alluvium or colluvium on hills and terraces.

3.6.2.5.3.1 Designated Farmland

The percentage of designated farmland within the ROI of Region 3 is provided in Table 3.6.2-6.

Table 3.6.2-6:
Designated Farmland in Region 3 (Percentage of ROI)

Project Component	Total Acres in ROI	Prime Farmland (%)	Total Designated Farmland (%)[1]
AR 3-A	4,612	38	38
AR 3-B	5,851	40	40
AR 3-C	14,860	53	53
AR 3-D	4,814	70	70
AR 3-E	1,073	52	52
APR	19,760	50	50

GIS Data Source: NRCS (2013)
1 Total designated farmland categories that are present ("prime farmland" is the only category present in the Region 3 ROI).

3.6.2.5.3.2 Soil Limitations

Existing soil limitations within Region 3 are summarized in Table 3.6.2-7 by Project component.

Table 3.6.2-7:
Soil Limitations in Region 3 (Percentage of ROI)

Project Component	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony/ Rocky Soil[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 3-A	86	28	23	43	0	<1	69	5	<1
AR 3-B	87	27	24	46	0	<1	66	4	<1
AR 3-C	75	25	33	48	12	<1	50	12	0
AR 3-D	100	11	55	70	<1	0	34	7	0
AR 3-E	99	13	33	76	0	0	54	28	0
APR	79	22	34	55	9	0	53	10	<1

GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO High concrete or steel corrosion potential.
5 SSURGO soils characterized as stony, cobbly, channery, flaggy, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 Restrictive layer is < 60 inches from ground surface.

3.6.2.5.3.3 Soil Contamination

Three facilities/sites that are required to report activity to a state or federal system were identified within the ROI based on EPA FRS database information. They include an EPA Hazardous Waste Report BR site and two RCRAInfo sites. The BR site is indicative of EPA data reporting of generation, minimization, and management of hazardous waste.

3.6.2.5.4 Region 4

Boston Mountains MLRA

The ROI crosses one MLRA, the Boston Mountains MLRA, and ultisols and inceptisols soil orders are predominant. These are described above under Region 3.

3.6.2.5.4.1 Designated Farmland

The percentage of designated farmland within the ROI of Region 4 is provided in Table 3.6.2-8.

Table 3.6.2-8:
Designated Farmland in Region 4 (Percentage of ROI)

Project Component	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland [5] (%)
AR 4-A	7,160	19	0	4	3	4	23
AR 4-B	9,610	16	0	<1	<1	3	19

Table 3.6.2-8:
Designated Farmland in Region 4 (Percentage of ROI)

Project Component	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland [5] (%)
AR 4-C	425	13	0	0	0	9	22
AR 4-D	3,106	27	0	<1	<1	6	32
AR 4-E	4,491	42	0	<1	1	9	53
APR	15,414	35	<1	<1	1	8	45

GIS Data Source: NRCS (2013)

1 Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.
2 Prime farmland if protected from flooding or not frequently flooded during the growing season.
3 Prime farmland if drained with no other qualifications.
4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.
5 Total of designated farmland categories present in the Region 4 ROI.

3.6.2.5.4.2 Soil Limitations

Existing soil limitations within the ROI are summarized in Table 3.6.2-9 by Project component.

Table 3.6.2-9:
Soil Limitations in Region 4 (Percentage of ROI)

Project Component	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony/Rocky Soils[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 4-A	24	22	7	75	54	10	84	52	<1
AR 4-B	21	21	6	65	53	6	79	53	1
AR 4-C	32	19	17	64	49	0	100	49	0
AR 4-D	19	42	6	58	32	10	87	29	1
AR 4-E	21	48	15	33	27	1	59	12	1
APR	42	29	22	63	33	5	58	25	2

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as stony, cobbly, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer <60 inches from ground surface.

3.6.2.5.4.3 Soil Contamination

Nine facilities that are required to report activity to a state or federal system were identified within the Region 4 ROI based on EPA FRS database information. The facilities include an EPA Hazardous Waste Report BR site, a RCRAInfo site, an eGRID site, an EIA-860 site, an NPDES site, and a PDS site. eGRID and EIA-860 sites indicate that data exist for electric power generation sites in the area, with one site generating more than 1MW.

3.6.2.5.5 Region 5

Boston Mountains MLRA

Region 5 is entirely located within the Boston Mountains MLRA. This MLRA and its associated soils are described in above in Region 4.

A more detailed description of soils in the area of the Arkansas Convertor Station Alternative Siting Area includes three soil associations: Nell-Enders Mountainburg, Mountainburg Linker, and Leadvale–Taft (NRCS 2014b). Nells–Enders Mountainburg soils are well drained, gently sloping to very steep, deep and shallow, loamy soils that are gravelly or stony, and are often found on hills or mountains. The soils formed in loamy and clayey residuum weathered from sandstone and shale. The soils are unsuited for crop cultivation and have a high shrink swell potential; and have a shallow depth to bedrock. Mountainburg Linker soils are well drained, nearly level to moderately deep, loamy soils; some gravelly or stony. These soils are often located on hills or mountains, and are formed in loamy and residuum weathered from level-bedded sandstone. The Leadvale-Taft soils are moderately well-drained and somewhat poorly drained, level to gently sloping, deep, loamy soils with fragipans. These soils are often found on old stream terraces in broad valleys, and are formed in loamy sediment weathered from sandstone and shale washed from local uplands. The primary limitations associated with these soils are slow permeability and erosion hazards.

3.6.2.5.5.1 Designated Farmland

The percentage of designated farmland in the ROI in Region 5 is provided in Table 3.6.2-10.

Table 3.6.2-10:
Designated Farmland in Region 5 (Percentage of ROI)

Project Component	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland[5] (%)
AR 5-A	1,553	41	0	0	0	2	43
AR 5-B	8,686	47	<1	0	0	4	51
AR 5-C	1,137	69	1	0	0	4	74
AR 5-D	2,660	36	0	4	6	<1	46
AR 5-E	4,449	51	1	0	0	5	57
AR 5-F	2,748	53	1	0	0	8	62
APR	13,777	32	<1	2	1	3	38
Arkansas Converter Station Siting Area	21,862	31	1	0	0	5	37
Arkansas AC Interconnection	9,624	49	9	0	0	11	69

GIS Data Source: NRCS (2013)

1 Prime farmland if drained with no other qualifications.

2 Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.

3 Prime farmland if protected from flooding or not frequently flooded during the growing season.

4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.

5 Total designated farmland categories present in the Region 5 ROI.

3.6.2.5.5.2 Soil Limitations

Existing soil limitations within the ROI in Region 5 are summarized in Table 3.6.2-11 by Project component.

Table 3.6.2-11:
Soil Limitations in Region 5 (Percentage of ROI)

Project Component Area	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony Soil[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 5-A	13	46	8	38	32	0	83	30	0
AR 5-B	20	60	14	32	16	0	92	16	0
AR 5-C	31	47	22	26	21	0	91	10	0
AR 5-D	45	19	30	58	36	8	78	13	0
AR 5-E	25	58	19	37	16	0	94	11	0
AR 5-F	35	53	24	50	13	0	92	10	0
APR	22	46	12	57	31	4	87	19	1
Arkansas Converter Station Siting Area	23	46	10	53	31	0	82	27	0
Arkansas Interconnect	61	39	10	53	13	0	82	13	0

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting hazard.

2 SSURGO Wind Erosion Groups: 1–3 and 4L.

3 SSURGO Kf > 0.4.

4 SSURGO high concrete or steel corrosion potential.

5 SSURGO soils characterized as stony, cobbly, flaggy, channery, bouldery, and bedrock.

6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).

7 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.5.3 Soil Contamination

Thirteen facilities that are required to report activity to a state or federal system were identified within the ROI based on EPA FRS database information. They include an NPDES site and 12 PDS sites.

3.6.2.5.6 Region 6

Southern Mississippi River Alluvium MLRA

The ROI crosses two areas of the southern Mississippi River Alluvium MLRA characterized as the alluvial plain along the lower Mississippi River, south of its confluence with the Ohio River. The landforms in the area are level or depressional to very gently undulating alluvial plains, backswamps, oxbows, natural levees, and terraces. Landform shapes range from convex on natural levees and undulating terraces to concave in oxbows (GIS Data Source: NRCS 2006). Average elevations gradually rise from the south/southeast to the northwest.

Most of this area is used for cropland and about 29 percent of this MLRA is not protected from flooding (including most areas of forested wetlands), and flooding occurs occasionally or frequently in these unprotected areas. Levees protect nearly all of the cropland, urban land, and grassland from flooding. Networks of drainage canals and ditches help to remove excess surface water from the cropland. Soil resource concerns are control of surface water, management of soil moisture, and maintenance of the content of organic matter and productivity of the soils. Conservation practices on cropland generally include nutrient management, crop residue management, and alternative tillage systems, especially no-till systems that reduce the cost of tillage. In many areas land leveling or shaping optimizes the control of surface water and the potential for soil erosion (GIS Data Source: NRCS 2006).

Alfisols, vertisols, inceptisols, and entisols are the predominant soil orders in the MLRA. The soils temperature regime is thermic, has an aquic soil moisture regime, has smectitic clay mineralogy, and mixed sand and silt fraction mineralogy. The soils are very deep, dominantly poorly drained and somewhat poorly drained, and dominantly loamy or clayey. Soils are present in areas of alluvial flats and backswamps of Holocene to late Pleistocene age, nearly level to gently sloping soils in natural levees of Holocene age, nearly level to gently undulating, sandy soils in levee splays and point bars of Holocene age, and nearly level to gently undulating in terraces of Pleistocene age.

Southern Mississippi Valley Loess MLRA

This area is characterized by sharply dissected plains that have a loess mantle that is thick at the valley wall but thins rapidly as distance from the valley wall increases (GIS Data Source: NRCS 2006). Valley sides are hilly to steep, especially in the western part of the MLRA. Intervening ridges generally are narrow and rolling, but some of the interfluves between the upper reaches of the valleys are broad and flat. Stream valleys are narrow in the upper reaches but broaden rapidly downstream and have wide flat flood plains and meandering stream channels. Elevation ranges from 80 to 600 feet.

Soil resource concerns are water erosion, maintenance of the content of organic matter and productivity of the soils, and management of soil moisture. Water erosion is a hazard in sloping areas that are bare because of tree harvesting. Soil conservation practices on forestland generally include systems of tree residue management and reforestation. Conservation practices on cropland generally include crop residue management, which increases the content of organic matter in the soils, and applications of lime in areas of low pH. Many of the soils remain wet or have a high water table for some or most of the year.

Alfisols, entisols, inceptisols, and ultisols are the predominant soil orders in the MLRA. The soils in the area are very deep or deep, are medium textured, and have a thermic soil temperature regime, audic soil moisture regime, and mixed mineralogy. Well drained, nearly level to very steep soils are on uplands. Nearly level to steep, well-drained soils and moderately well drained and somewhat poorly drained soils and moderately well drained soils, and well-drained soils formed in thick deposits of loess. Nearly level to gently sloping, somewhat poorly drained soils, moderately well drained soils, well drained to somewhat poorly drained soils, and well drained soils formed in deposits of loess 2 to 4 feet thick. Nearly level and very gently sloping, somewhat poorly drained and poorly drained soils, somewhat poorly drained soils, somewhat poorly drained soils, and somewhat poorly drained soils formed in a thin mantle of loess over loamy alluvium or mixed loess and loamy alluvium. Deep, gently sloping, well drained soils, somewhat poorly drained soils, and somewhat poorly drained soils formed in silty material or in a mantle of loess and the underlying late Pleistocene loamy terrace material. In the eastern part of the area, where the loess mantle thins, well drained soils and moderately well drained soils, all of which are gently sloping to steep, are on ridgetops and side slopes. Well drained soils moderately well drained soils, and somewhat poorly drained soils are on floodplains.

3.6.2.5.6.1 Designated Farmland

Percentages of designated farmland in the affected environment ROI for Region 6 are provided in Table 3.6.2-12.

Table 3.6.2-12:
Designated Farmland in Region 6 (Percentage of ROI)

Project Component Area	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland[5] (%)
AR 6-A	1,982	28	22	2	6	6	65
AR 6-B	1,724	37	24	11	9	2	61
AR 6-C	2,857	29	33	10	0	10	81
AR 6-D	1,134	8	24	17	8	21	79
APR	6,652	23	31	4	4	20	82

GIS Data Source: NRCS (2013)
1 Prime farmland if drained with no other qualifications.
2 Prime farmland if drained <u>and</u> either protected from flooding or not frequently flooded during the growing season.
3 Prime farmland if protected from flooding or not frequently flooded during the growing season.
4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.
5 Total designated farmland categories present in the Region 5 ROI.

3.6.2.5.6.2 Soil Limitations

Existing soil limitations within the ROI in Region 6 are summarized in Table 3.6.2-13 by Project component.

Table 3.6.2-13:
Soil Limitations in Region 6 (Percentage of ROI)

Project Component Area	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony/Rocky Soil[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 6-A	94	26	73	93	0	37	60	0	0
AR 6-B	93	16	83	92	0	17	57	0	0
AR 6-C	93	0	81	67	0	22	47	7	0
AR 6-D	78	0	26	51	0	60	1	0	0
APR	92	10	58	70	0	30	47	2	0

GIS Data Source: NRCS (2013)

1 SSURGO severe rutting potential.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as cobbly, stony, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.6.3 Soil Contamination

No areas of potential soil contamination were identified within the Region 6 ROI based on EPA FRS database information.

3.6.2.5.7 Region 7

<u>Southern Mississippi River Alluvium MLRA</u>

The ROI in Region 7 crosses the Southern Mississippi River Alluvium MLRA, and alfisols, vertisols, inceptisols, and entisols are the dominant soil orders. These are described above under Region 6.

<u>Southern Mississippi Valley Loess MLRA</u>

The ROI in Region 7 crosses the Southern Mississippi Valley Loess MLRA, and alfisols, entisols, inceptisols, and utisols are the dominant soil orders. These are described above under Region 6.

The soils located within the Shelby Convertor Station Siting Area are classified in the Memphis-Adler association. These soils consist of very deep moderately to somewhat poorly drained soils that formed in thick loess, silty alluvium, or water reworked loess deposits on broad nearly level to strongly sloping uplands and stream terraces.

3.6.2.5.7.1 Designated Farmland

Percentages of designated farmland in the affected environment ROI for Region 7 are provided in Table 3.6.2-14.

Table 3.6.2-14:
Designated Farmland in Region 7 (Percentage of ROI)

Project Component Area	Total Acres in ROI	Prime Farmland (%)	Prime Farmland if Drained[1] (%)	Prime Farmland if Drained[2] (%)	Prime Farmland if Protected[3] (%)	Farmland of State and Local Importance[4] (%)	Total Designated Farmland[5] (%)
AR 7-A	5,259	10	22	35	29	1	96
AR 7-B	1,055	49	0	0	0	0	49
AR 7-C	2,887	65	0	0	0	0	65
AR 7-D	803	54	0	0	0	0	54
APR	5,226	25	19	20	14	2	80
Tennessee Converter Station Siting Area[6]	743	62	0	0	0	0	62

GIS Data Source: NRCS (2013).

1 Prime farmland if drained with no other qualifications.

2 Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season.

3 Prime farmland if protected from flooding or not frequently flooded during the growing season.

4 This is land, in addition to prime and unique farmland, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Criteria for defining and delineating this land are to be determined by the appropriate state agency or agencies.

5 Total designated farmland categories present in the Region 7 ROI.

6 The Tennessee AC Interconnection would be located within the siting area.

3.6.2.5.7.2 Soil Limitations

Existing soil limitations within the ROI for Region 7 are summarized in Table 3.6.2-15 by Project component.

Table 3.6.2-15:
Soil Limitations in Region 7 (Percentage of ROI)

Project Component Area	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Hydric Soils[5]	Restrictive Layer[6]	15 to 30 Percent Slopes	>30 Percent Slopes
AR 7-A	92	18	18	67	33	0	0	0
AR 7-B	97	0	84	17	18	9	22	5
AR 7-C	99	0	94	50	18	23	8	2
AR 7-D	100	0	98	8	3	10	15	0
APR	90	9	38	44	32	4	7	1
Tennessee Converter Station Siting Area	99	46	98	45	22	30	10	0

GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO Kf > 0.4.
4 SSURGO high steel or concrete corrosion potential.
5 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
6 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.7.3 Soil Contamination

Two facilities that are required to report activity to a state or federal system were identified within the Region 6 ROI based on EPA FRS database information. The facilities are two PDS sites. Seven facilities are located in the area of the Tennessee Converter Station Siting Area including five PDS sites, one NPDES site, and one TRI site.

3.6.2.5.8 Connected Actions

3.6.2.5.8.1 Wind Energy Generation

Southern High Plains, Northern Part MLRA

Wind energy generation in the WDZs would occur in the Southern High Plains and Northern Part MLRA. Alfisols and mollisols are the dominant soil orders. These are described above under Region 1.

3.6.2.5.8.1.1 Designated Farmland

Percentages of designated farmland in the WDZs are provided in Table 3.6.2-16. Farmland of state and local important is not designated or present in the WDZs in Oklahoma and is not included in the table.

Table 3.6.2-16:
Designated Farmland in WDZs (Percentage of ROI)

WDZ	Total Acres in WDZ ROI	Prime Farmland (%)	Prime Farmland if Protected[1] (%)	Total Designated Farmland[2] (%)
A	109,747	68	0	68
B	125,479	59	<1	59
C	161,048	49	<1	49
D	69,189	45	0	45
E	47,092	75	0	75
F	112,461	51	0	51
G	187,315	60	0	60
H	116,226	43	0	43
I	105,203	59	0	59
J	92,567	32	0	32
K	92,894	85	0	85
L	165,848	73	0	73

GIS Data Source: NRCS (2013).
1 Prime farmland if protected from flooding or not frequently flooded during the growing season.
2 Total designated farmland categories present in the WDZ.

3.6.2.5.8.1.2 Soil Limitations

Existing soil limitations within the WDZ ROIs are summarized in Table 3.6.2-17 by Project component.

Table 3.6.2-17:
Soil Limitations in WDZs (Percentage of ROI)

WDZ	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	Corrosion Potential[3]	Hydric Soils[4]	Restrictive Layer[5]	15 to 30 Percent Slopes	>30 Percent Slopes
A	25	25	67	0	4	2	0
B	81	35	70	0	2	3	0
C	37	46	49	<1	4	3	<1
D	18	55	1	<1	12	0	0
E	10	25	2	<1	9	0	0
F	11	49	8	<1	6	7	0
G	21	40	45	<1	1	<1	0
H	8	57	26	<1	7	0	0
I	7	41	1	1	<1	0	0
J	64	60	17	0	11	<1	0
K	53	15	38	0	0	0	0
L	23	19	66	0	7	3	0

GIS Data Source: NRCS (2013)
1 SSURGO severe rutting hazard.
2 SSURGO Wind Erosion Groups: 1–3 and 4L.
3 SSURGO high steel or concrete corrosion potential.
4 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
5 SSURGO restrictive layer < 60 inches from ground surface.

3.6.2.5.8.1.3 Soil Contamination

Facilities that are required to report activity to a state or federal system for the WDZ boundaries are listed in Table 3.6.2-18. The presence of most of these sites on the databases indicate a records inventory of such regulated sites and do not raise a concern at this time in regards to potential areas of soil contamination. Exceptions include the CERCLA site located in the city of Perryton, Texas (WDZ-A), and the LUST-ARRA sites located in Hardesty, Oklahoma (WDZ-D). These sites are indicated to be in some stage of clean-up under regulatory authority.

Table 3.6.2-18:
FRS Sites in WDZs

WDZ	Total Number of Sites	Sites
A	83 (74 in the vicinity of Perryton, TX)	NPDES (2);ICIS (10); RCRAinfo (34); CERCLIS (City of Perryton Well No. 2); SPCC (1); TCEQ ACR (35)
B	11	NPDES (5); ICIS (1); TCEQ ACR (5)
C	26	NPDES (9); RCRinfo (2); Toxic Substances Control Act (1); TRI (1); TCEQ ACR (13)
D	2	LUST-ARRA (2)
E	3	ICIS (2); NPDES (1)
F	19 (16 within Texhoma, OK)	NPDES (9): ICIS (6); TRI (1); NCDB (3)
G	3	BR (1), RCRAinfo (1); NPDES (1)
H	None	NA
I	16	NPDES (5); ICIS (6); RCRAinfo (1); NCDB (3); SSTS (1)
J	None	NA
K	None	NA
L	11	NPDES (2); TCEQ ACR (9)

GIS Data Source: EPA (2014b)

3.6.2.5.8.2 Optima Substation

General soil characteristics are the same as those described for the western area of Region 1. The future Optima substation is composed of 7.5 acres (5 percent of the 160-acre site) of prime farmland. Fifteen acres (9 percent of the site) is within areas susceptible to high compaction; and 153 acres (95 percent of the site) is within areas of moderate to high wind erosion potential.

3.6.2.5.8.3 TVA Upgrades

As described above under Section 3.1.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.6.2.6 Impacts to Soils

3.6.2.6.1 Methodology

Impacts to soils from HVDC transmission lines were analyzed based on a 200-foot representative ROW (see Section 3.1). Other Project components were analyzed based on the ROI, recognizing that the actual construction footprints would be smaller than the ROI. Areas of potential disturbance (which would affect soils) are provided in Appendix F for transmission tower footprints, tensioning and pulling sites, access roads, multi-use construction staging yards, and fiber optic regeneration sites. Because specific locations have not been identified for these Project features, an evaluation of designated farmland, soil limitation parameters, and potential contaminated sites is not possible at this time.

3.6.2.6.1.1 Impacts Common to All Project Components

Temporary and short-term impacts to soils would occur during construction, long-term impacts during operations and maintenance, and temporary and short-term impacts during decommissioning. The implementation of EPMs and associated management plans would minimize or avoid impacts to soils and reduce long-term and permanent effects to the extent practicable. Potential impacts from Project activities are discussed below.

Vegetation Removal

Vegetation would be cut and/or removed during construction for equipment access, safe construction purposes and to ensure long-term electrical safety clearances, maintenance, and reliability of the transmission lines. Vegetation would also be removed as necessary for construction and operation of the converter stations. Vegetation removal could indirectly affect soils by increasing potential for wind and water erosion, reducing water and nutrient holding capacity, impacting porosity, and reducing a soil's ability to filter sediments. Removal of trees could alter soil moisture by decreasing evapotranspiration rates and may increase soil temperature because of a lack of shade. Erosion may result in loss of valuable topsoil from its original location through wind and/or water erosion. Reestablishing soil-protective vegetation cover would be performed to minimize and avoid soil erosion. Vegetation removal and vegetation maintenance would be ongoing during the operation phase of the Project for the safe operation of the transmission lines. Specific impacts to vegetation are discussed in Section 3.17.

Maintenance activities for operation and maintenance of facilities would be similar to activities during construction but generally smaller in scale and more localized and infrequent. The ROW would be maintained during operations and maintenance in accordance with a TVMP developed for the Project, consistent with NESC standards. The wire zone typically consists of low-growing grasses, legumes, herbs, crops, ferns, and shrubs where the conductor is 50 feet or less from the ground, to prevent accidental grounding contact with conductors. The border zone (i.e., to the edge of the ROW) is managed to consist of tall shrubs or short trees (up to 25 feet in height at maturity), grasses, and forbs. In most areas, standard utility practices consistent with the TVMP, such as tree-trimming and/or brush removal, would be used to maintain vegetation on the ROW.

Grading and Excavation

Grading can directly affect surface soils, resulting in soil mixing and increased wind and water erosion potential. The Project has the potential to cause soil mixing where grading or excavation is required. The mixing of topsoil with subsoil during these activities could result in the loss of soil fertility, loss of seedbank present in the topsoil, and introduction of rock into the topsoil. Construction activities in areas of stony/rocky soils may result in a concentration of large clasts near the surface. Erosion may result in loss of valuable topsoil from its original location through wind and/or water erosion. Reestablishing soil-protective vegetation cover would be performed to minimize and avoid soil erosion.

Impacts to soil resources from construction activities are associated with clearing, grading, excavation, and other activities necessary for construction of the converter station, access roads and the transmission line structures and lines. Impacts during construction could expose erosion-prone soils to conditions of increased erosion potential; soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment.

Construction disturbance to areas of steep slopes could cause increased erosion hazards in these areas and reclamation of these areas might be more difficult and less successful.

Blasting

Blasting of bedrock might be required in the some areas of the Project. Blasting activities have the potential to cause soil mixing and the introduction of rock into the topsoil. Erosion may result in loss of valuable topsoil from its original location through wind and/or water erosion and could lead to poor revegetation following construction.

Access Road Construction and Use

Construction and use of access roads during Project construction could result in direct impacts to soil from rutting and compaction. Construction and use of access roads would range from overland travel in areas with low vegetation, to grading in steep areas. Driving construction equipment through soils can crush vegetation and compact soils, particularly where soils are prone to compaction. The degree of compaction depends on the moisture content and texture of the soil at the time of construction.

Fuel and Lubricant Handling

Inadvertent spills of fluids used during construction, such as fuel, lubricants, antifreeze, detergents, paints, solvents, and herbicides could directly affect soils through contamination.

Previously Contaminated Soils

Excavation activities during construction might uncover previously unknown areas of contaminated soils. Contaminated soils might cause hazardous conditions for workers and cause construction delays and, if disturbed, might allow contaminants to migrate to surrounding soil and water resources.

Herbicide Use

The Applicant may selectively apply herbicides during clearing and grading for construction to minimize regrowth of certain trees and woody species. Herbicides may be toxic to soil organisms and could have a temporary direct impact on the revegetation potential of the area depending on the type used and the concentration.

Dewatering

Open excavations and trenches may occasionally accumulate water as groundwater seeps in or from precipitation. When that occurs, the excavations and trenches may require periodic dewatering to allow for proper and safe construction, which may lead to soil erosion if the water is discharged directly to the ground and soil is washed away.

Conversion of Designated Farmland

Areas of the Project mapped as designated farmland may be irreversibly converted. In those areas, the NRCS would require a farmland conversion assessment, or Form AD-1006, to be submitted for evaluation (Sagona 2014). Once the exact locations of Project components have been determined, the farmland conversion assessment would be completed by the NRCS.

Operations and Maintenance

Operations and maintenance impacts to soils generally depend on the area of ground affected by operations and maintenance activities within ROWs, along access roads, and at facility sites such as converter stations. Soil resources may be temporarily affected by periodic vegetation maintenance during the operations and maintenance phase of the Project. Impacts from the construction and use of access roads might expose soils to erosion and compaction. Impacts to soils include permanent removal of soils from other potential uses and ongoing minimal impacts from maintenance activities along Project ROWs. Maintenance activities such as the use of trucks and heavy equipment to maintain low vegetation could result in damage to drainage and ground vegetation along ROWs that might expose soils to erosion and compaction hazards. The application of EPMs would help minimize or avoid impacts to soils during operations and maintenance.

Decommissioning

Decommissioning of the Project could result in impacts to soil resources, similar to those for construction (e.g., increased sedimentation, erosion, soil compaction, limited direct removal of vegetation, and accidental spills of chemicals). Decommissioning would result in an overall decrease in impacts to soil resources because the acreage associated with the structures and ROWs would be available for long-term reclamation.

3.6.2.6.1.2 Environmental Protection Measures

Clean Line would develop and implement the following plans as part of the Project:

- Blasting Plan: This plan will describe measure designed to minimize adverse effects due to blasting.
- Restoration Plan: This plan will describe post-construction activities to reclaim disturbed areas.
- Spill Prevention, Control and Countermeasures (SPCC) Plan: This plan will describe the measures designed to prevent, control, and cleanup spills of hazardous materials.
- Storm Water Pollution Prevention Plan (SWPPP): This plan, consistent with federal and state regulations, would describe the practices, measures, and monitoring programs to control sedimentation, erosion, and runoff from disturbed areas.
- Decommissioning Plan: This plan would describe all measures necessary to ensure the prevention of erosion, compaction, and other adverse impacts to soils during decommissioning. The plan would also include post-decommissioning activities to reclaim disturbed areas.

A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would reduce impacts to soils or minimize the potential for release or mismanagement of hazardous constituents that could eventually result in an impact on soils are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations.
- GE-4: Vegetation removed during clearing will be disposed of according to federal, state, and local regulations.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement (s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions to the extent practicable. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.

- GE-9: Clean Line will avoid damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces to the extent practicable. If these features or improvements are inadvertently damage, they will be repaired and or restored to the extent practicable.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-12: Clean Line will avoid remedial structures (e.g., capped areas, monitoring equipment, or treatment wells) on contaminated sites, Superfund sites, CERCLA remediation sites, and other similar sites. Workers will use appropriate protective equipment and appropriate safe working techniques when working at or near contaminated sites.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.
- GE-30: Clean Line will minimize the amount of time that any excavations remain open.
- AG-1: Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems.
- AG-2:–Agricultural soils directly impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions to the extent practicable. Appropriate soil remediation efforts may include decompaction, liming, tillage, fertilization, or use of other soil amendments.
- AG-3: Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands.
- AG-4: Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms.
- GEO-1: As appropriate, Clean Line will stabilize exposed slopes to minimize erosion.

- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-8: Dewatering will be conducted in a manner designed to prevent soil erosion (e.g., through discharge of water to vegetated areas and/or the use of flow control devices).

3.6.2.6.2 Impacts Associated with the Applicant Proposed Project

3.6.2.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.6.2.6.2.1.1 Oklahoma and Tennessee Converter Station and AC Interconnection Siting Areas

3.6.2.6.2.1.1.1 Construction Impacts

No areas of designated farmland are present in the Oklahoma Converter Station Siting Area and 8 percent (73 acres) of the Oklahoma AC Interconnection Siting Area contains designated farmland. The Tennessee Converter Station Siting Area and AC Interconnection Siting Area consist of 62 percent (459 acres) designated farmland. Depending on the specific siting of these AC interconnect lines, impacts from construction activities could include exposing prime farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil. Depending on the specific siting of the converter stations, areas susceptible to erosion and hydric soils could be avoided or impacted during construction activities.

Two facilities (one NPDES site and one TRI site) that are required to report activity to a state or federal system were identified in the Tennessee Converter Station Siting Area. The NPDES site, located within the northeastern portion of the siting area, indicates a stone and gravel operation where a permit was granted in 2008 for the discharge of stormwater. The TRI site is the existing Shelby 500kV substation. These sites indicate a records inventory and do not raise a concern at this time in regards to areas of soil contamination.

3.6.2.6.2.1.1.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.2.1.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.2.2 AC Collection System

3.6.2.6.2.2.1 Construction Impacts

The amounts of designated farmland for the AC collection system routes are summarized in Table 3.6.2-19. The AC collection system routes representative ROWs only traverse areas of prime farmland and do not traverse other categories of designated farmland and therefore the other categories are not presented in the table.

Table 3.6.2-19:
Designated Farmland—AC Collection System Routes 200-Foot Representative ROW (Percentage and Acreage)

AC Collection System Route	Total Representative ROW (acres)	Total Designated Farmland Impacted[1] (acres and percentage of representative ROW)
E-1	708	142 (20%)
E-2	974	502 (51%)
E-3	977	432 (44%)
NE-1	730	367(50%)
NE-2	637	209 (33%)
NW-1	1,265	646 (51%)
NW-2	1,365	670 (49%)
SE-1	979	517 (53%)
SE-2	325	167 (49%)
SE-3	1,194	671 (56%)
SW-1	326	9 (3%)
SW-2	901	108 (12%)
W-1	508	193 (38%)

GIS Data Source: NRCS 2013: In Route E-1 designated farmland is present in 42% of the larger ROI; and in Route E-2 designated farmland is present in 19% of the larger ROI.

1 Includes all designated farmland categories (prime farmland is the only category present in the AC collection system impact areas).

Impacts to soil limitation parameters for the 200-foot representative ROW of the AC collection system routes are summarized in Table 3.6.2-20.

One facility, the Lasley Cattle Feedlot (latitude/longitude: 36.2994/-101.82411), is a NPDES stormwater discharge permit site identified within the AC Collection System Route SW-2. Discharge from the feedlot is indicated to be permitted and does not pose a soil contamination concern at this time. Ten other facilities/sites that are required to report activity to a state or federal system were identified in the surrounding AC collection system ROI. Based on available information, these sites do not pose a soil contamination concern.

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Table 3.6.2-20:
Soil Limitations—AC Collection System Routes 200-Foot Representative ROW (Percentage and Acreage)

Project Component Area	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Summary of Impact Comparison to All AC Collection System Routes (unless otherwise specified)
E-1	97%	688	79%	560	0%	0	9%	62	0%	0	0%	0	20%	138	0%	0	0%	0	Among the highest impacts to soils with high wind erosion potential.
E-2	99%	963	45%	435	0%	0	30%	291	0%	0	0%	0	8%	81	0%	0	0%	0	Among the highest impacts to soils with moderate to high wind erosion potential.
E-3	98%	955	51%	500	0%	0	10%	99	0%	0	0%	0	12%	117	0%	0	0%	0	Among the highest impacts to soils with high wind erosion potential.
NE-1	97%	707	50%	363	0%	0	4%	28	0%	0	<1%	2	9%	63	0%	0	0%	0	In the medium range of impact to soils susceptible to moderate to high wind erosion.
NE-2	95%	609	67%	429	0%	0	3%	17	0%	0	2%	10	19%	119	0%	0	0%	0	More impact to soils with moderate to high wind erosion potential than NE-1 and is among the greatest of impacts to soils with high wind erosion potential.
NW-1	96%	1,209	49%	620	0%	0	27%	340	0%	0	0%	0	5%	64	0%	0	0%	0	Less impact to soils with moderate to high wind erosion potential than NW-2 and is one of the highest impacts to soils with moderate to high wind erosion potential.
NW-2	9%	127	51%	695	0%	0	26%	351	0%	0	0%	0	5%	71	0%	0	0%	0	More impact to soils with moderate to high wind erosion potential than NW-1 and is among the highest impact to soils with moderate to high wind erosion potential.
SE-1	21%	203	45%	436	0%	0	51%	500	0%	0	0%	0	7%	69	0%	0	0%	0	More impact to soils with moderate to high wind erosion potential than SE-2 and SE-3 and is among the highest impact to soils with moderate to high wind erosion potential.
SE-2	100%	325	35%	112	0%	0	52%	170	0%	0	0%	0	20%	66	14%	46	0%	0	Less impact to soils with moderate to high wind erosion potential than SE-1 and more impact than SE-3 and is among the least impact to soils with moderate to high wind erosion potential.

Table 3.6.2-20:
Soil Limitations—AC Collection System Routes 200-Foot Representative ROW (Percentage and Acreage)

Project Component Area	High Compaction Potential[1]	Moderate to High Wind Erosion Potential[2]	High Water Erosion Potential[3]	Corrosion Potential[4]	Stony Soils[5]	Hydric Soils[6]	Restrictive Layer[7]	15 to 30% Slopes	>30% Slopes	Summary of Impact Comparison to All AC Collection System Routes (unless otherwise specified)
SE-3	99% 1,182	41% 76	0% 0	45% 531	0% 0	0% 0	7% 81	0% 0	0% 0	Less impact to soils with moderate to high wind erosion potential than SE-1 and SE-2 and has the least impact to soils with moderate to high wind erosion potential.
SW-1	83% 269	76% 246	0% 0	0% 0	0% 0	0% 0	20% 66	12% 40	0% 0	Less impact to soils with moderate to high wind erosion potential than SW-2 and is among the medium impact to soils with moderate to high wind erosion potential.
SW-2	92% 831	86% 779	0% 0	20% 180	0% 0	0% 0	10% 86	5% 43	0% 0	More impact to soils with moderate to high wind erosion potential than Has the highest impact to soils with high wind erosion potential.
W-1	94% 478	62% 315	0% 0	4% 19	0% 0	0% 0	9% 43	0% 0	0% 0	Among the medium range of impact to soils susceptible to high wind erosion.

GIS Data Source: NRCS (2013). In AC Collection System Route E-2, moderate to high wind erosion potential is present in 49% of the larger ROI. In AC Collection System Route NW-2, high compaction potential is present in 88% of the larger ROI. In AC Collection System Route SE-1, high compaction potential is present in 89% of the larger ROI.

1 SSURGO severe rutting hazard.
2 SSURGO WEG wind erosion groups: 1-4L.
3 SSURGO Kf >0.4.
4 SSURGO High steel or concrete potential.
5 SSURGO soils characterized as stony, cobbly, channery, flaggy, bouldery, or bedrock
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 Bedrock < 60 inches from ground surface.

3.6.2.6.2.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.2.2.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.2.3 HVDC Applicant Proposed Route

3.6.2.6.2.3.1 Construction Impacts

Acreages and percentages of designated farmland for the Applicant Proposed Route 200-foot representative ROW are provided in Table 3.6.2-21 by Project region. The total impact to designated farmland from the Applicant Proposed Route encompasses 48 percent (or 8,321 acres). The greatest impacts to designated farmland are in Regions 1 and 3. The greatest impact to the "farmland–if–drained" category is in Region 6; the greatest impact to "farmland if drained and either protected from flooding or not frequently flooded during the growing season" is in Region 7. The greatest impact to farmland of statewide and local importance is in Region 6. Temporary impacts in the tensioning areas would impact 1,682 acres within the Applicant Proposed Route.

Table 3.6.2-21:
Designated Farmland in Applicant Proposed Route 200-Foot Representative ROW—All Regions (Percentage and Acreage)

Applicant Proposed Route by Region	Total Acres of Representative ROW	Total Designated Farmland (acres and percentage of Impact Area)[1]
Region 1	2,825	1,405 (50%)
Region 2	2,588	593 (23%)
Region 3	3,949	1,961 (50%)
Region 4	3,088	1,382 (42%)
Region 5	2,760	1,052 (38%)
Region 6	1,332	1,097 (78%)
Region 7	1,048	836 (81%)
Total APR (all Regions)	17,590	8,321 (48%)

GIS Data Source: NRCS (2013)
1 Includes total for all designated farmland categories.

<u>Soil Limitations</u>

Impacts to soil limitation parameters for the Applicant Proposed Route impact areas are summarized in Table 3.6.2-22 by Project region. Impacts to soils with high compaction potential are greater than 1,000 acres in Regions 1, 2, 3, and 4. Total impacts to soils with high compaction potential could occur for 56 percent (9,996 acres) of the Applicant Proposed Route. Wind erosion potential is greatest in Regions 1, 2, and 5, with total impact to 6,648 acres potentially occurring in all Regions for this parameter. Water erosion potential is greatest in Regions 3, 4, and 6. Steep slopes are most prevalent in Regions 3, 4, and 5. Impacts associated with soil limitations are further discussed by Region below. Temporary impacts in the tensioning areas would impact 949 acres of soils with high compaction potential with the Applicant Proposed Route.

Soil Contamination

No areas of potential soil contamination were identified within the Applicant Proposed Route Regions 1, 2, 3, 4, and 6 representative ROWs or larger ROI. The representative ROW in Region 5 includes the DeSoto Gathering/Phillips Mountain gas facility, located along Applicant Proposed Link 3. The representative ROW in Region 7 includes a PDS site, Mitchell Station. The PDS site could be indicative of any number of potential reported issues. Additional information would be obtained for the site during final design to ascertain if avoidance of the area is necessary.

3.6.2.6.2.3.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.2.3.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.3 Impacts Associated with the DOE Alternatives

3.6.2.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.6.2.6.3.1.1 Construction Impacts

The Arkansas Converter Station Alternative Siting Area is located within 8,197 acres of designated farmland, and the AC Interconnection Siting Area within 9,624 acres of designated farmland. The converter station would require 40 to 60 acres of land. The AC interconnection representative ROW includes 146 acres, 105 acres (or 72 percent) within designated farmland. Depending on the specific siting of the converter station and AC interconnect line within these areas, impacts from construction activities could include exposing designated farmland to conditions of increased erosion potential, and soils with high compaction potential would be susceptible to compaction from construction vehicles and equipment. Either impact could result in a decrease in the productivity of such soils and a loss of fertile topsoil.

Five sites were identified in the Arkansas converter station ROI. All are private farmstead or ranch locations. Implementation of EPMs would minimize potential contamination of soils.

3.6.2.6.3.1.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.3.1.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

Table 3.6.2-22:
Soil Limitations in Applicant Proposed Route 200-Foot Representative ROW—All Regions (Percentage and Acreage)

Project Component Area	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes	
Region 1	91%	2,582	52%	1,461	<1%	9	26%	744	0%	0	0%	0	12%	328	2%	63	0%	0
Region 2	41%	1,050	73%	1,889	9%	229	17%	428	0%	0	0%	0	18%	475	4%	112	0%	0
Region 3	80%	3,153	23%	923	35%	1,367	55%	2,181	9%	361	0%	0	54%	2,118	10%	390	<1%	6
Region 4	42%	1,309	29%	892	22%	677	64%	1,969	33%	1,031	4%	137	59%	1,836	25%	779	2%	64
Region 5	23%	626	45%	1,246	13%	351	57%	1,567	31%	852	4%	98	87%	2,399	16%	447	1%	32
Region 6	92%	324	10%	136	58%	766	71%	948	0%	0	31%	407	47%	622	2%	29	0%	0
Region 7	91%	952	10%	101	39%	405	44%	462	0%	0	32%	339	5%	54	7%	77	2%	19
Total	56%	9,996	38%	6,648	22%	3,804	47%	8,299	13%	2,244	6%	981	45%	7,832	11%	1,897	1%	121

GIS Data Source: NRCS (2013)
1 SSURGO severe rutting potential
2 SSURGO WEG wind erosion groups: 1-4L
3 SSURGO Kf >0.4
4 SSURGO high concrete or steel corrosion potential
5 SSURGO soils characterized as cobbly, stony, flaggy, channery, bouldery, and bedrock
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils)
7 SSURGO restrictive layer < 60 inches from ground surface

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3.6.2.6.3.2 HVDC Alternative Routes

3.6.2.6.3.2.1 Construction Impacts

Construction impacts to soil resources would be similar to those of the Application Proposed, but acres of designated farmland and soil limitations would vary by route alternatives. The amounts of designated farmland and soil limitations for HVDC alternative routes representative ROWs and the Applicant Proposed Route are compared for each region in Tables 3.6.2-23 and 3.6.2-24, respectively. Impacts for the individual alternatives are summarized and compared with the Applicant Proposed Route in the far right column of the tables.

No areas of potential soil contamination were identified within the HVDC alternative routes representative ROW or ROI for Regions 1, 2, 3, or 6. An eGRID site and an EIA-860 site occur in the 200-foot representative ROW for HVDC Alternative Route 4-B. These are electric power generation facilities and are not indicative of a potential contamination concern at this time. Another two facilities/sites were identified in the Region 4 HVDC alternatives ROI, but also do not raise a concern at this time in regards to areas of soil contamination. No sites/facilities were identified in the representative ROW for the HVDC alternative routes in Regions 5 or 7. Thirteen facilities/sites were identified in the Region 5 ROI and two in the Region 7 ROI, but they do not raise concerns at this time in regards to areas of soil contamination.

3.6.2.6.3.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance are described in Section 3.6.2.6.1.

3.6.2.6.3.2.3 Decommissioning Impacts

Impacts from decommissioning are described in Section 3.6.2.6.1.

3.6.2.6.4 Best Management Practices

One BMP has been identified that could avoid and minimize impacts to soils:

- If signs of contaminated soils are uncovered during construction activities, work would be stopped in the area of potentially contaminated soils until appropriate Project representatives could be consulted.

3.6.2.6.5 Unavoidable Adverse Impacts

The Project would result in unavoidable impacts to soil resources during construction and operations and maintenance phases. Removal of vegetation during construction grading and excavation activities associated with the Project could result in the exposure of soils to erosion and compaction of soils susceptible to compaction. Transmission line structures and converter station sites would permanently impact agricultural soils and remove them from productivity during construction and operations and maintenance. Access roads used during construction would temporarily remove agricultural soils from productivity, and the use of unpaved access roads during all Project phases could result in the exposure of soils to erosion and compaction. All Project phases could result in the loss of fertile topsoil from activities that would either remove topsoil or expose topsoil to erosion. Adverse impacts therefore include the potential depletion of soil productivity, including erosion and loss of fertile topsoil and potential erosion of exposed areas and compaction of areas traversed by equipment and vehicles. Reclamation activities and Applicant EPMs would be implemented to avoid and minimize adverse impacts to soil resources. However, the loss of soil resources used for agricultural activities within the Project footprint during construction and operations and maintenance of the Project is unavoidable.

3.6.2.6.6 Irreversible and Irretrievable Commitment of Resources

An irreversible commitment of soil resources during the life span of the Project would occur until all transmission line concrete foundations, converter station facilities, and access roads are removed and successful reclamation is achieved for soils at the ground surface.

3.6.2.6.7 Relationship between Local Short-term Uses and Long-Term Productivity

Overall site productivity is primarily a matter of revegetation/reclamation success and availability for agricultural or other uses. Impacts to short-term uses of soil resources would result from construction and operations and maintenance of the Project, while impacts to long-term productivity would depend on the success of the reclamation activities. Short-term impacts are associated with land areas directly affected by construction and operations and maintenance of the Project. Short-term impacts include the construction and use of access roads during the construction phase of the Project and the use of access roads for operations and maintenance. Other short-term impacts to soil resources could occur at the footprint areas of construction work areas, converter station sites, transmission line structures, fiber optic sites, and construction tensioning and pulling areas. These areas could all be returned to other productive uses following decommissioning. A decrease in the long-term productivity of soils would result if soils were not reclaimed to their existing quality condition including such characteristics as aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics that are accepted as beneficial to overall plant growth and establishment.

3.6.2.6.8 Impacts from Connected Actions

3.6.2.6.8.1 Wind Energy Generation

3.6.2.6.8.1.1 Construction Impacts

The potential impacts to soils common to all Project components (Section 3.6.2.6.1.1) apply to similar activities during wind energy generation. Specific locations of wind generation facilities are not known at this time and therefore specific impacts to designated farmland, soil limitation parameters, or contaminated soil cannot be determined. Based on the general characteristics of the WDZs, some affected soils may be susceptible to compaction or have moderate to high wind erosion potential. The remaining soil limitation characteristics are not prominent in the WDZs.

Most of the EPA FRS sites located in WDZs are indicative of a records inventory of such regulated sites and do not raise a concern at this time in regards to areas of soil contamination. If wind development is considered in feedlot discharge areas, areas of potential leaking storage tanks, or other potential contaminant release areas, the developers may collect additional information to avoid potential soil contamination.

3.6.2.6.8.1.2 Operations and Maintenance

Permanent wind farm facilities that would impact soils include turbine footprint areas, collector lines, substations, meteorological towers, operation and maintenance buildings, and access roads for the maintenance and operation of these facilities. A conservative estimate is that this infrastructure would impact 1 percent of each WDZ-where wind energy generation occurs. Permanent facilities would typically be maintained for proper drainage and vegetation specifications and would not contribute to soil erosion hazards. Placement of these facilities in areas of steep slopes would typically be avoided or minimized to prevent erosion or other hazards.

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[1]	Impact Comparison with Applicant Proposed Route Corresponding Links
Region 1				
AR 1-A	2, 3, 4, 5	3,003	805 (27%)	Less impact to designated farmland.
AR 1-B	2, 3	1,268	564 (44%)	Less impacts to designated farmland.
AR 1-C	2, 3	1,272	679 (53%)	Less impact to designated farmland. Greater impacts to designated farmland than 1-B.
AR 1-D	3, 4	819	330 (40%)	Somewhat greater impacts to designated farmland.
APR Link 1	NA	48	0 (0%)	NA
APR Link 2	NA	1,301	873 (67%)	NA
APR Link 3	NA	15	13 (87%)	NA
APR Link 4	NA	808	305 (38%)	NA
APR Link 5	NA	654	215 (33%)	NA
Region 2				
AR 2-A	2	1,396	335 (24%)	Greater impacts to designated farmland.
AR 2-B	3	728	365 (50%)	Greater impacts to designated farmland.
APR Link 1	NA	494	31 (6%)	NA
APR Link 2	NA	1,331	260 (20%)	NA
APR Link 3	NA	764	302 (40%)	NA
Region 3				
AR 3-A	1	919	339 (37%)	Fewer impacts to designated farmland.
AR 3-B	1, 2, 3	1,167	457 (39%)	Somewhat less effects to designated farmland.
AR 3-C	3, 4, 5, 6	2,968	1,577 (53%)	Somewhat more impact to designated farmland.
AR 3-D	5, 6	959	676 (71%)	Greater impact to designated farmland.
AR 3-E	6	208	110 (53%)	Similar impacts to designated farmland.
APR Link 1	NA	977	375 (38%)	NA
APR Link 2	NA	77	27 (36%)	NA
APR Link 3	NA	167	95 (57%)	NA
APR Link 4	NA	1,872	827 (56%)	NA

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[1]	Impact Comparison with Applicant Proposed Route Corresponding Links
APR Link 5	NA	667	529 (79%)	NA
APR Link 6	NA	190	107 (57%)	NA
APR Link 5	NA	67	60 (90%)	NA
APR Link 6	NA	25	13 (54%)	NA
Region 4				
AR 4-A	3, 4, 5, 6	1,426	316 (22%)	Less impacts to designated farmland.
AR 4-B	2, 3, 4, 5, 6, 7, 8	1,920	352 (18%)	Less impacts to designated farmland.
AR 4-C	5	83	19 (23%)	Slightly greater effect to designated farmland.
AR 4-D	4, 5, 6	618	200 (32%)	Less impacts to designated farmland than the corresponding APR links.
AR 4-E	8, 9	897	503 (56%)	Slightly greater impacts to designated farmland.
APR Link 1	NA	203	37 (18%)	NA
APR Link 2	NA	103	12 (12%)	NA
APR Link 3	NA	856	190 (22%)	NA
APR Link 4	NA	26	1 (2%)	NA
APR Link 5	NA	53	9 (16%)	NA
APR Link 6	NA	540	465 (86%)	NA
APR Link 7	NA	360	177 (49%)	NA
APR Link 8	NA	50	21 (41%)	NA
APR Link 9	NA	897	471 (52%)	NA
Region 5				
AR 5-A	1	308	137 (44%)	Greater impacts to designated farmland.
AR 5-B	3, 4, 5, 6	1,732	878 (51%)	Much greater impacts to designated farmland.
AR 5-C	6	225	166 (74%)	Greater impacts to designated farmland.
AR 5-D	9	530	248 (47%)	Less impacts to designated farmland.
AR 5-E	4, 5, 6	885	498 (56%)	Much greater impacts to designated farmland.
AR 5-F	5, 6	544	341 (63%)	Greater impacts to designated farmland.

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[1]	Impact Comparison with Applicant Proposed Route Corresponding Links
APR Link 1	NA	300	121 (40%)	NA
APR Link 2	NA	158	34 (22%)	NA
APR Link 3	NA	830	206 (25%)	NA
APR Link 4	NA	352	128 (36%)	NA
APR Link 5	NA	350	122 (35%)	NA
APR Link 6	NA	109	80 (74%)	NA
APR Link 7	NA	120	77 (64%)	NA
APR Link 8	NA	40	13 (33%)	NA
APR Link 9	NA	500	275 (54%)	NA
Region 6				
AR 6-A	2, 3, 4	396	140 (65%)	Less impact to designated farmland.
AR 6-B	3	344	200 (58%)	More impact to designated farmland.
AR 6-C	6, 7	566	487 (86%)	Less impact to designated farmland.
AR 6-D	7	224	214 (95%) (a)	Slightly more impact to designated farmland.
APR Link 1	NA	150	139 (92%)	NA
APR Link 2	NA	42	25 (59%)	NA
APR Link 3	NA	236	130 (55%)	NA
APR Link 4	NA	155	134 (87%)	NA
APR Link 5	NA	46	43 (93%)	NA
APR Link 6	NA	397	323 (81%)	NA
APR Link 7	NA	209	208 (99%)	NA
APR Link 8	NA	96	94 (98%)	NA
Region 7				
AR 7-A	1	1,052	1,000 (95%)	Greater impact to designated farmland.
AR 7-B	3, 4	210	97 (46%)	Less impact to designated farmland.
AR 7-C	3, 4, 5	579	381 (66%)	Greater impact to designated farmland.
AR 7-D	4, 5	160	91 (57%)	Less impact to designated farmland.

Table 3.6.2-23:
Designated Farmland in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	Total Acres in Representative ROW	Total Designated Farmland (Acres and percentage of impact area)[1]	Impact Comparison with Applicant Proposed Route Corresponding Links
APR Link 1	NA	698	644 (92%)	NA
APR Link 2	NA	27	27 (100%)	NA
APR Link 3	NA	166	68 (41%)	NA
APR Link 4	NA	39	36 (92%)	NA
APR Link 5	NA	118	61 (52%)	NA

1 Includes all farmland categories that apply in each region.
NA—Not applicable.
NE—Not evaluated for tensioning areas.

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
Region 1																				
AR 1-A	2, 3, 4, 5	90%	2,707	69%	2,065	1%	16	8%	236	0%	0	0%	0	19%	582	5%	150	0%	0	Greater impacts to high compaction soils, soils with wind erosion potential, and areas of steep slopes.
AR 1-B	2, 3	99%	1,250	52%	660	0%	0	12%	151	0%	0	0%	0	8%	100	0%	0	0%	0	Less impact to high compaction soils and greater impact to soils with wind erosion potential and areas of steep slopes.
AR 1-C	2, 3	99%	1,254	46%	583	0%	0	12%	156	0%	0	0%	0	5%	63	0%	0	0%	0	Less impact to high compaction soils and greater impact to soils with wind erosion potential and areas of steep slopes than.
AR 1-D	3, 4	94%	767	73%	594	<1%	1	27%	218	0%	0	0%	0	6%	46	0%	0	0%	0	Somewhat more impact to high compaction soils and areas of steep slopes and less impact to soils with wind erosion potential.
APR Link 1	NA	100%	48	100%	48	0%	0	0%	0	0%	0	0%	0	62%	29	0%	0	0%	0	NA
APR Link 2	NA	99%	1,289	30%	391	0%	0	41%	537	0%	0	0%	0	3%	40	0%	0	0%	0	NA
APR Link 3	NA	100%	15	13%	2	0%	0	65%	10	0%	0	0%	0	0%	0	0%	0	0%	0	NA
APR Link 4	NA	92%	740	77%	622	0%	0	22%	179	0%	0	0%	0	3%	25	0%	0	0%	0	NA
APR Link 5	NA	75%	491	61%	399	<1%	9	3%	19	0%	0	0%	0	36%	234	10%	63	0%	0	NA
Region 2																				
AR 2-A	2	63%	879	78%	1,082	14%	202	26%	362	0%	0	0%	0	39%	550	10%	139	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, and areas of steep slopes. Greater overall soils impacts.
AR 2-B	3	80%	585	38%	278	13%	93	29%	210	0%	0	0%	0	41%	299	0%	0	0%	0	Greater impact to high compaction soils and areas of steep slopes and less impact to soils with wind erosion potential. Greater overall soils impacts.
APR Link 1	NA	9%	43	96%	474	0%	0	4%	22	0%	0	0%	0	0%	0	0%	0	0%	0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
APR Link 2	NA	41%	550	75%	1,004	5%	72	12%	157	0%	0	0%	0	22%	296	6%	76	0%	0	NA
APR Link 3	NA	60%	457	54%	411	20%	156	33%	248	0%	0	0%	0	24%	180	5%	35	0%	0	NA
Region 3																				
AR 3-A	1	86%	790	29%	265	23%	215	43%	398	0%	0	<1%	1	69%	631	6%	51	0%	0	Less impact to high compaction soils and to soils with wind erosion potential.
AR 3-B	1, 2, 3	87%	1,016	27%	320	25%	292	47%	546	0%	0	<1%	1	66%	774	5%	61	0%	0	Slightly less impact to high compaction soils. Somewhat less overall soils impacts.
AR 3-C	3, 4, 5, 6	76%	2,245	25%	729	33%	969	47%	1,398	12%	364	<1%	6	50%	1,480	13%	389	0%	0	Less impact to high compaction soils; greater impact to soils with wind erosion potential and to areas of steep slopes. Somewhat greater overall soils impacts.
AR 3-D	5, 6	100%	954	11%	105	55%	524	69%	660	<1%	1	0%	0	33%	320	8%	73	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, and areas of steep slopes. The alternative route would have somewhat greater overall soils impacts.
AR 3-E	6	99%	206	13%	26	34%	70	77%	161	0%	0	0%	0	54%	112	30%	63	0%	0	Greater impact to high compaction soils and areas of steep slopes.
APR Link 1	NA	84%	825	33%	320	20%	197	34%	332	0%	0	0%	0	65%	638	6%	60	1%	6	NA
APR Link 2	NA	82%	63	28%	22	45%	34	79%	60	0%	0	0%	0	39%	30	13%	10	0%	0	NA
APR Link 3	NA	83%	138	35%	58	29%	49	51%	84	0%	0	0%	0	46%	76	4%	7	0%	0	NA
APR Link 4	NA	68%	1,276	23%	434	29%	550	57%	1,065	19%	361	0%	0	59%	1,107	14%	264	0%	0	NA
APR Link 5	NA	100%	665	8%	56	69%	459	72%	482	0%	0	0%	0	25%	170	0%	0	0%	0	NA
APR Link 6	NA	98%	187	17%	32	41%	78	83%	157	0%	0	0%	0	52%	98	26%	49	0%	0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
Region 4																				
AR 4-A	3, 4, 5, 6	24%	345	21%	303	7%	97	75%	1,073	54%	768	<1%	3	85%	1,212	52%	741	<1%	4	Less impact to high compaction soils, soils with high water erosion potential and greater impact to areas of steep slopes. Somewhat less overall soils impacts.
AR 4-B	2, 3, 4, 5, 6, 7, 8	21%	402	22%	413	5%	103	65%	1,246	53%	1,018	0%	0	80%	1,528	53%	1,020	1%	20	Less impact to high compaction soils, soils with wind erosion potential, and soils with high water erosion potential and greater impact to areas of steep slopes.
AR 4-C	5	31%	26	19%	15	18%	15	64%	53	50%	42	0%	0	100%	83	50%	42	0%	0	Similar impacts to soil limitation parameters.
AR 4-D	4, 5, 6	19%	118	43%	263	6%	37	58%	357	31%	194	1%	3	88%	545	29%	177	1%	4	Less impact to high compaction soils, soils with wind erosion potential, and soils with high water erosion potential and would have greater impact to areas of steep slopes.
AR 4-E	8, 9	21%	186	48%	435	16%	146	31%	279	25%	222	0%	0	57%	513	12%	105	1%	8	Less impact to high compaction soils and soils with high water erosion potential and would have greater impact to areas of steep slopes and soils with wind erosion potential.
APR Link 1	NA	51%	104	3%	5	17%	34	69%	140	51%	103	0%	0	59%	120	63%	127	0%	0	NA
APR Link 2	NA	34%	35	0%	0	9%	9	97%	99	66%	68	0%	0	77%	79	66%	68	0%	0	NA
APR Link 3	NA	57%	491	1%	8	25%	215	95%	811	47%	406	0%	0	62%	532	42%	361	0%	0	NA
APR Link 4	NA	23%	6	12%	3	2%	<1	86%	22	40%	10	0%	0	100%	26	40%	10	0%	0	NA
APR Link 5	NA	20%	11	38%	20	6%	3	56%	30	42%	22	0%	0	100%	53	42%	22	0%	0	NA
APR Link 6	NA	59%	316	53%	284	34%	182	71%	385	9%	51	25%	136	38%	207	9%	51	0%	0	NA
APR Link 7	NA	31%	112	51%	182	17%	61	25%	91	28%	101	<1	1	75%	268	18%	64	0%	0	NA
APR Link 8	NA	25%	13	44%	22	24%	12	16%	8	29%	15	0%	0	64%	32	9%	5	0%	0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
APR Link 9	NA	25%	222	41%	267	18%	160	42%	380	28%	255	0%	0	58%	518	8%	70	7%	64	NA
Region 5																				
AR 5-A	1	13%	41	44%	136	8%	26	41%	125	34%	104	0%	0	83%	256	33%	101	0%	0	Less impact to high compaction soils and soils with wind erosion potential and would have greater impact to areas of steep slopes than APR Link 1.
AR 5-B	3, 4, 5, 6	20%	352	59%	1,019	14%	247	33%	564	17%	288	0%	0	92%	1,591	17%	287	0%	0	More impact to high compaction soils, soils with wind erosion potential, and areas of steep slopes and less impact to stony soils.
AR 5-C	6	32%	73	46%	104	24%	53	25%	57	21%	47	0%	0	91%	205	11%	24	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, soils with high water erosion potential, areas of steep slopes, and stony soils. Overall greater impact to soils susceptible to soil limitations.
AR 5-D	9	45%	240	20%	108	31%	162	58%	310	35%	183	7%	36	79%	416	11%	58	0%	0	Less impact to high compaction soils, soils with high water erosion potential, and areas of steep slopes and more impact to soils with wind erosion potential and stony soils.
AR 5-E	4, 5, 6	26%	228	58%	512	19%	169	38%	332	16%	145	0%	0	95%	837	12%	103	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, soils with high water erosion potential, and areas of steep slopes and less impact to stony soils.
AR 5-F	5, 6	36%	196	52%	283	25%	138	50%	271	12%	65	0%	0	92%	501	10%	56	0%	0	Greater impact to high compaction soils, soils with wind erosion potential, soils with high water erosion potential, and areas of steep slopes and less impact to stony soils.

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
APR Link 1	NA	17%	51	49%	146	8%	23	51%	153	36%	108	0%	0	89%	267	31%	94	0%	0	NA
APR Link 2	NA	12%	18	30%	47	11%	18	46%	73	44%	69	0%	0	83%	131	51%	81	0%	0	NA
APR Link 3	NA	14%	116	50%	414	4%	35	62%	511	32%	268	0%	0	91%	753	25%	208	1%	8	NA
APR Link 4	NA	10%	35	69%	242	6%	20	69%	242	23%	82	0%	0	99%	350	3%	11	0%	0	NA
APR Link 5	NA	8%	29	48%	168	4%	13	58%	202	43%	152	0%	0	95%	333	12%	42	7%	24	NA
APR Link 6	NA	42%	47	32%	35	20%	21	31%	34	14%	15	0%	0	76%	83	0%	0	0%	0	NA
APR Link 7	NA	5%	6	70%	85	4%	4	35%	42	24%	29	0%	0	91%	109	20%	24	0%	0	NA
APR Link 8	NA	0%	0	33%	13	0%	0	67%	27	67%	27	0%	0	100%	40	53%	21	0%	0	NA
APR Link 9	NA	65%	324	19%	97	43%	217	57%	283	21%	103	20%	98	66%	332	9%	46	0%	0	NA
Region 6																				
AR 6-A	2, 3, 4	95%	375	25%	98	75%	297	94%	371	0%	0	37%	148	60%	238	0%	0	0%	0	Less impact to high compaction soils and soils with high water erosion potential and greater impact to hydric soils.
AR 6-B	3	94%	324	15%	52	84%	288	94%	322	0%	0	19%	64	61%	209	0%	0	0%	0	More impact to high compaction soils, soils with wind erosion potential, and soils with high water erosion potential. Overall greater impacts to soils with soils limitations.
AR 6-C	6, 7	98%	555	0%	0	86%	486	72%	408	0%	0	25%	139	46%	262	7%	42	0%	0	Less impact to high compaction soils and hydric soils and greater impact to soils with high water erosion potential and to areas of steep slopes.
AR 6-D	7	95%	213	0%	0	40%	88	68%	152	0%	0	71%	158	2%	4	0%	0	0%	0	Less impact to high compaction soils and hydric soils and would have greater impact to soils with high water erosion potential.
APR Link 1	NA	73%	109	26%	39	46%	69	69%	103	0%	0	10%	15	7%	10	0%	0	0%	0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
APR Link 2	NA	72%	30	28%	12	72%	30	72%	30	0%	0	0%	0	41%	17	0%	0	0%	0	NA
APR Link 3	NA	94%	222	14%	34	85%	201	93%	219	0%	0	27%	64	74%	173	0%	0	0%	0	NA
APR Link 4	NA	99%	154	30%	47	69%	107	98%	152	0%	0	30%	47	56%	88	0%	0	0%	0	NA
APR Link 5	NA	99%	46	0%	0	99%	46	94%	43	0%	0	0%	0	93%	43	0%	0	0%	0	NA
APR Link 6	NA	93%	369	1%	5	79%	315	73%	192	0%	0	8%	31	73%	291	7%	29	0%	0	NA
APR Link 7	NA	99%	208	0%	0	0%	0	28%	58	0%	0	99%	208	0%	0	0%	0	0%	0	NA
APR Link 8	NA	98%	94	0%	0	0%	0	54%	52	0%	0	44%	43	0%	0	0%	0	0%	0	NA
Region 7																				
AR 7-A	1	91%	958	19%	202	17%	174	64%	676	0%	0	33%	352	0%	0	0%	0	0%	0	More impact to high compaction soils, soils with high water erosion potential, soils with high wind erosion potential, and hydric soils. Overall greater impacts to soils with soil limitations.
AR 7-B	3, 4	97%	203	0%	0	86%	180	18%	38	0%	0	18%	37	6%	13	23%	49	4%	9	More impact to hydric soils. Otherwise, impacts to soils with soil limitations are similar.
AR 7-C	3, 4, 5	98%	570	0%	0	94%	546	54%	310	0%	0	18%	106	23%	134	8%	49	2%	9	More impact to high compaction soils, soils with high water erosion potential, and hydric soils. Greater overall impacts to soils with soil limitations.
AR 7-D	4, 5	100%	160	0%	0	100%	159	8%	13	0%	0	3%	4	9%	14	15%	24	0%	0	Less impact to areas of steep slopes. Otherwise, impacts are similar in terms of soil limitation parameters.
APR Link 1	NA	87%	607	10%	101	16%	109	56%	390	0%	0	40%	280	0%	0	0%	0	0%	0	NA
APR Link 2	NA	100%	27	0%	0	0%	0	100%	27	0%	0	100%	27	0%	0	0%	0	0%	0	NA

Table 3.6.2-24:
Soil Limitations in HVDC Alternative Routes by Region (Percentage and Acreage in 200-Foot Representative Corridor)

Project Component Area	Associated APR Link Numbers	High Compaction Potential[1]		Moderate to High Wind Erosion Potential[2]		High Water Erosion Potential[3]		Corrosion Potential[4]		Stony Soils[5]		Hydric Soils[6]		Restrictive Layer[7]		15 to 30% Slopes		>30% Slopes		Alternative Route Compared to Applicant Proposed Route Corresponding Links
APR Link 3	NA	97%	161	0%	0	84%	139	12%	20	0%	0	13%	22	11%	19	31%	52	8%	13	NA
APR Link 4	NA	100%	39	0%	0	100%	39	1%	1	0%	0	0%	0	36%	14	0%	0	0%	0	NA
APR Link 5	NA	99%	118	0%	0	99%	118	21%	25	0%	0	9%	11	18%	21	21%	25	5%	6	NA

GIS Data Source: NRCS (2013)
1 SSURGO severe rutting potential.
2 SSURGO WEG wind erosion groups: 1-4L.
3 SSURGO Kf >0.4.
4 SSURGO high concrete or steel corrosion potential.
5 SSURGO soils characterized as cobbly, stony, flaggy, channery, bouldery, and bedrock.
6 SSURGO Hydric Condition (includes only entirely hydric soils and not partially hydric soils).
7 SSURGO restrictive layer < 60 inches from ground surface.

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Permanent impacts to designated farmland during operations and maintenance would include conversion of the operations and maintenance facility, wind turbine, substation, and access roads to these facilities. Temporary construction areas would be reclaimed for potential farmland use. Designated farmland could continue to be used in areas above underground lines and surrounding these facilities and structures. Agricultural activities such as cultivating crops and livestock grazing are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be removed from production for the life of the Project, although long-term access roads and the configuration of wind turbines may change the configuration of fields for crops and grazing.

Operation and maintenance activities have the potential to result in the release of fuels, oil, hydraulic fluid, and other potential contaminants to area soils. Such releases would be most likely to occur at wind turbines, substations, and the operations and maintenance facilities. Operations practices generally include measures to avoid releases of contaminant materials. However, in the event of such releases, immediate actions would be generally implemented to contain and clean up such materials. Adsorbent and containment materials would be generally stored in appropriate areas and workers would likely be trained for such events.

3.6.2.6.8.1.3 Decommissioning Impacts

Wind farm decommissioning could occur at the end of the useful life of the facilities and if the facilities were no longer required. Decommissioning of the WDZs could result in temporary impacts to soil resources, similar to those for construction (e.g., increased sedimentation, erosion, soil compaction, limited direct removal of vegetation, and accidental spills of chemicals). Impacts related to soil disturbance during decommissioning are anticipated to be similar to construction but would be temporary. Impacts to soils would be associated with the removal of wind farm infrastructure, temporary storage of waste and demolition debris, temporary access roads for such removal, and any related clearing and grading that might be necessary. Similar EPMs and BMPs that would be implemented during decommissioning activities for the Project would typically be implemented for the wind generation facilities to avoid and minimize impacts to soil resources.

3.6.2.6.8.2 Optima Substation

Potential impacts to designated farmland may occur, including potential conversion to utility uses. Construction activities may result in soil compaction and erosion given the susceptibility of existing soils. Implementation of a SWPPP would reduce the likelihood for soil erosion.

3.6.2.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

General impacts from the construction of the new 500kV transmission line would be similar to those described for the Project. Depending on the locations of the required TVA upgrades, ground-disturbing activities could result in decreased productivity and quality of designated farmland and in places of permanent structures some farmland could be taken out of production. Site-specific soil characteristics would determine the potential for erosion impacts to erosion-prone or steep soils or potential compaction impacts from construction vehicles and equipment to soils with high compaction potential. The upgrades to existing transmission lines and the new transmission line, like the Project, are linear (long, narrow) projects with relatively small amounts of ground disturbance considering the amount of area crossed.

3.6.2.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed and soils would not be impacted. The land would continue to be used for existing agricultural and other uses.

Contents

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Figures Presented in Appendix A

3.7 Groundwater

3.7.1 Regulatory Background

Laws and regulations associated with the management and protection of groundwater could affect the Project or the manner in which it would be implemented. Key elements of select federal and state laws and regulations associated with groundwater management are summarized in Table 3.7-1.

Table 3.7-1:
Federal and State Laws and Regulations Associated with Groundwater Management

Statute/Regulation	Key Elements
Safe Drinking Water Act (42 USC § 300f *et seq.*)	Establishes measures to protect the quality of public water supplies and sources of drinking water Requires states to develop Wellhead Protection Programs to protect public water supply wells
Oklahoma	
Oklahoma Administrative Code 785:30, "Taking and Use of Groundwater"	Requires a permit for use of groundwater for any purpose other than domestic use
Oklahoma Administrative Code 785:45, "Oklahoma's Water Quality Standards"	Establishes groundwater protection measures through groundwater classification, beneficial use designations, and vulnerability level designations Specifies that no groundwater degradation will be allowed that will interfere with attainment or maintenance of an existing or designated beneficial use
Oklahoma Administrative Code 785:46, "Implementation of Oklahoma's Water Quality Standards"	Ensures compliance with the anti-degradation standard by limiting permitted groundwater withdrawals to the maximum annual yield and avoiding withdrawals that would cause contaminated groundwater or surface water to move into groundwater not already contaminated
Arkansas	
Arkansas Act 1051 of 1985	Requires non-domestic users of groundwater or a natural spring involving potential flow rates of more than 50,000 gallons per day to report withdrawals to the Arkansas Natural Resources Commission (ANRC) (pre-use notification is not required)
Arkansas Act 154 of 1991	Requires the ARNC to define critical groundwater areas, sustainable yield, and groundwater level trends and gives ANRC authority to regulate groundwater use in designated critical groundwater areas (such regulations have not yet been proposed)
Arkansas Act 472 of 1949	Establishes authority for development and implementation of groundwater quality standards, which are currently being drafted by the ANRC
Tennessee	
Chapter 0400-40-03, General Water Quality Criteria	Establishes groundwater classifications and quality criteria Describes TDEC authority to require remediation when a release or other event causes groundwater to not meet applicable quality criteria Requires landowner or prospective purchaser of property to notify TDEC if groundwater testing shows contamination in excess of applicable groundwater quality criteria
Chapter 0400-45-08, Water Registration Requirements	Requires users withdrawing water from either a surface or groundwater source at an average rate of 10,000 gallons or more per day to be pre-registered with the TDEC (agricultural, emergency and certain non-recurring withdrawals are exempt) Purchase of water from a utility is not considered withdrawal
Texas	
Texas Administrative Code 30-293.19 and 30-294.41–294.44	Sets procedures for the designation of Priority Groundwater Management Areas and issues related to creation of Groundwater Conservation Districts in designated management areas

3.7.2 Data Sources

Data were obtained from multiple publicly available sources. Because of the length of the area being evaluated as part of the Project, the analysis relies strongly on GIS datasets (GIS Data Sources: EPA 2011; ODEQ 2012;, OWRB 2014, 2011a; AWWCC 2014; TWDB 2013; Clean Line 2013b, 2013c; USGS 2014a, 2004a) to develop a picture of resources within the ROI. GIS datasets were obtained primarily from federal and state programs. For example, the USGS National Hydrography Dataset was used as part of the effort to characterize the affected environment. Databases kept by state agencies were also used to search for specific groundwater-related information such as locations of leaking underground storage tanks. Representatives of state agencies were contacted in some cases and information was obtained via conversations or electronic correspondence. Much of the information presented in this section was obtained from state webpages.

Water use information presented in this section is from the USGS and is for the year of 2005. The USGS compiles water use data every 5 years, but data for 2010 are not expected to be available until late 2014.

3.7.3 Region of Influence

3.7.3.1 Region of Influence for the Project

The ROI considered in the groundwater affected environment and subsequent evaluation of potential impacts varied by Project component and by specific environmental evaluations. The baseline ROIs for the Project are as presented in Section 3.1.1. When considering wells and well systems for the groundwater evaluation, the 1,000-foot corridor ROI for transmission lines was increased by 150 feet on both sides to account for possible adverse effects of blasting, should it be required, within the main portions of the ROI. The ROI for the AC collection system, already at 2 miles wide, was not expanded for evaluating wells and well systems. The ROIs for groundwater evaluations other than wells and well systems are as described in Section 3.1.1.

3.7.3.2 Region of Influence for Connected Actions

The ROI for the wind energy generation, the future Optima Substation, and TVA upgrades is described in Section 3.1.1 for those actions.

3.7.4 Affected Environment

The affected environment for groundwater, as described separately for each region below, addresses the following elements:

- Principal Aquifers and Their Characteristics: The principal, or important, aquifers over which Project elements would be located are described for each region of the proposed HVDC transmission line route. The discussion of aquifer characteristics includes information, where available, on depths to the water table, groundwater quality, as well as areal extent. No EPA-designated sole-source aquifers occur within the Project ROI (GIS Data Source: EPA 2011).
- Groundwater of Special Interest: The ROI intersects areas where the applicable state has designated the underlying groundwater to be of particular value or concern. The discussion of each region below identifies the specific groundwater designations and the amount of area in which the various Project components overlie designated groundwater.
- Wells and Wellhead Protection Areas: The discussion of each region below identifies the number of public, domestic, agricultural, and industrial water supply wells located within the ROI for the various Project

components. Similarly, the discussion identifies the crossing areas for designated wellhead protection areas and the locations of springs (only applicable to Region 4).

- Groundwater Use: The discussion presents water use by county based on 2005 data published by the USGS. The USGS compiles water use data every 5 years, but data are not yet available for 2010 and are not expected to be available until late 2014. The USGS data are presented by use category and note whether the source is groundwater or surface water. To present a complete picture, a county's entire water use is presented together in a single table.

3.7.5 Regional Description

Because this EIS considers a linear project that covers a long distance, the area analyzed crosses many groundwater features. Rather than identifying individual features along the more than 700-mile route, the following sections present Regions 1–7 in terms of the compiled area or number of elements (Section 3.7.4) within the ROI. Only the more important or significant groundwater features or feature locations within each region are identified individually. The individual regional discussions identify the important aquifers that underlie that portion of the route. Figure 3.7-1 (located in Appendix A) depicts the locations of the aquifers beneath all seven of the regions.

The regional descriptions in this section also identify groundwater features and elements found within a representative ROW consisting of a 200-foot-wide corridor within the 1,000-foot-wide ROI of the HVDC transmission line routes. This information is used in evaluating potential impacts of the Project in Section 3.7.6. The ROW features and elements are included here in the affected environment in order to provide the reader an easy comparison between features in the ROI and what would be expected in a smaller ROW. Consistent with the ROI discussion of Section 3.7.3, well data for the ROW are based on a 500-foot-wide corridor (i.e., 150 feet added to each side of the 200-foot ROW) to incorporate wells or well systems that potentially could be impacted if blasting were done in the ROW.

3.7.5.1 Region 1

3.7.5.1.1 Region 1 Principal Aquifers and Their Characteristics

Much of Region 1 overlies the High Plains aquifer, one of five principal aquifers or aquifer systems along the ROI. The High Plains aquifer underlies a large area that includes parts of Texas, Colorado, Kansas, Nebraska, New Mexico, South Dakota, and Wyoming as well as western Oklahoma (GIS Data Sources: OWRB 2011a; USGS 2003). The aquifer, often referred to as the Ogallala Aquifer, consists of poorly consolidated layers of sand, silt, clay, and gravel with intermittent well-cemented zones of the Ogallala Formation (OWRB 2012). As shown in Figure 3.7-1 in Appendix A, the High Plains aquifer underlies the AC collection system routes as well as the Oklahoma Converter Station Siting Area. The eastern end of Region 1 is outside the general bounds of the High Plains aquifer. At its eastern end, Region 1 overlies an alluvial aquifer associated with the Beaver or North Canadian River. This aquifer is considered a major alluvial aquifer by the state (GIS Data Source: OWRB 2011a). As indicated by its name, the North Canadian River alluvial aquifer follows the path of the North Canadian River, which in this area is roughly from the northwest to the southeast.

In Oklahoma, the depth below ground surface (BGS) to the water table of the High Plains aquifer ranges from less than 10 feet to greater than 300 feet and the thickness of the saturated zone can range from nearly zero to almost 430 feet. Wells tapping into the High Plains aquifer commonly yield 500 to 1,000 gallons per minute and, in thick highly permeable areas, can yield up to 2,000 gallons per minute. Pumping rates throughout the aquifer, however, have typically exceeded recharge rates and declining groundwater levels have been common (OWRB 2012).

3.7.5.1.1.1 Aquifer Annual Yield

The maximum annual yield of an aquifer is the maximum amount of water that can be removed from a groundwater basin on an annual basis without degrading the groundwater resource. In Oklahoma, the concept of maximum annual yield carries the stipulation that the amount of groundwater removed must allow a minimum 20-year life for the basin. The state estimates the maximum annual yield of the portion of the High Plains aquifer that underlies the Oklahoma panhandle at about 2.29 million acre-feet (OWRB 2014), which equates to an average daily removal rate of just over 2,000 million gallons per day. When a maximum annual yield value is established and approved by the Oklahoma Water Resources Board, the state then distributes that yield across the groundwater basin to determine an equal proportionate share on a per-acre basis for overlying landowners. Within the Oklahoma panhandle, the equal proportionate share for the High Plains aquifer is set at 2 acre-feet of water per year per acre of land (OWRB 2014) or an average daily removal rate of about 1,790 gallons per acre.

With regard to the North Canadian River alluvial aquifer, the state has determined a maximum annual yield of 426,000 acre-feet for the section of the aquifer that extends roughly from the western border of Harper County, through Woodward County, and to the southern border of Major County (OWRB 2014). The eastern end of Region 1 overlies a small portion of the alluvial aquifer in Harper County. This annual yield equates to a removal rate of about 380 million gallons per day. The equal proportionate share for this section of the alluvial aquifer is set at 1 acre-foot of water per year per acre of land (OWRB 2014) or an average daily removal rate of about 890 gallons per acre.

3.7.5.1.1.2 Depths to Water Table

The USGS National Water Information System contains groundwater level information for most of the nation, including each of the four Oklahoma counties that are included within Region 1. To ensure the data were reflective of current groundwater levels, DOE first queried the USGS data system for information collected since the start of 2012. If no recent county data were available, as was the case for some counties along the transmission line routes, the query criteria were modified to include entries back through 2005. Based on water level measurements taken since the start of 2012, the water table in Texas County is typically about 94 to 370 feet BGS, and in Beaver County it ranges from 15 to 240 feet BGS. The water table in Harper and Woodward counties can be shallower, ranging from 3 to 170 feet BGS (USGS 2014).

According to recent (since 2012) data in the USGS data system, the five counties in which the AC collection system routes could be located (i.e., Beaver and Texas counties in Oklahoma and Sherman, Hansford, and Ochiltree counties in Texas) have depths to groundwater that range from 15 to 479 feet, with only Beaver County including a few wells with water table depths less than 30 feet (USGS 2014). But even in Beaver County, the average depth to groundwater for the reporting locations is greater than 100 feet and the averages in the other four counties are all greater than 200 feet.

3.7.5.1.1.3 Groundwater Quality

Groundwater quality of the High Plains aquifer in Oklahoma is considered generally good, although localized areas contain high nitrate levels (OWRB 2012). In general, water in the aquifer south of the Canadian River (roughly 40 to 50 miles south of the Region 1 area of the Oklahoma Panhandle) begins having diminishing water quality in terms of increasing concentrations of total dissolved solids. North of the river, total dissolved solids concentrations are typically less than 400 milligrams per liter; the National Secondary Drinking Water Regulations (40 CFR Part 143, for aesthetic qualities) standard is 500 milligrams per liter. South of the river, large areas have concentrations more than twice the standard (George et al. 2011).

3.7.5.1.2 Region 1 Groundwater of Special Interest

Within Oklahoma, groundwater of special interest that could be crossed by the HVDC transmission line routes or underlie other Project components includes groundwater areas designated by the state as a Class I Special Source Groundwater or a Nutrient Vulnerable Groundwater. Class I groundwaters are areas with exceptional water quality, an irreplaceable source of water, a need to maintain an outstanding resource, or ecologically important groundwater. Class I groundwaters are also considered to be very vulnerable to contamination. Oklahoma further divides Class I into Subclass A for groundwater underneath watersheds of “Scenic Rivers,” Subclass B for groundwater underneath lands designated by regulation (specifically, Appendix B of Oklahoma Administrative Code (OAC) 785-45), and Subclass C for groundwater underneath state approved wellhead or source water protection areas (OAC 785-45-7-3). This section’s discussion is limited to Subclass A and B groundwater; wellhead protection areas are discussed in Section 3.7.5.1.3. Oklahoma also classifies groundwater areas with Class II, III, or IV designations, which are not considered to be of special interest for the current discussion because Class II is for general use groundwater, and Classes III and IV are for groundwater that is naturally of poor quality.

“Nutrient-vulnerable groundwater” is a designation Oklahoma gives to certain hydrogeologic basins considered to have a high or very high vulnerability to contamination from surface sources of pollution. The groundwater basins for the North Canadian, Cimarron, and Arkansas rivers in the ROI in Oklahoma have been designated Nutrient Vulnerable.

No Class I groundwater occurs in Region 1, although several thousand acres of land overlying nutrient-vulnerable groundwater do occur as shown Table 3.7-2. Also shown in parentheses in Table 3.7-2 are reduced areas of land in the 200-foot corridor of the representative ROW that overlie groundwater of special interest.

Table 3.7-2:
Land Area in the 1,000-Foot Corridor (and the 200-Foot Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 1

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Total
Land Area Over Oklahoma Class 1 Special Source Groundwater—No groundwater of Class 1, Subclass A or B is within Region 1.						
Land Area Over Oklahoma Nutrient Vulnerable Groundwater						
APR (acres)	0	475 (96)	0	6 (0)	2,367 (474)	2,848 (570)
With AR 1-A (acres)	0	4,426 (884)				4,426 (884)
With AR 1-B (acres)	0	498 (101)		6 (0)	2,367 (474)	2,871 (575)
With AR 1-C (acres)	0	730 (147)		6 (0)	2,367 (474)	3,103 (621)
With AR 1-D (acres)	0	475 (96)	6 (0)		2,367 (474)	2,848 (570)

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.

2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.

GIS Data Sources: OWRB (2011b, 2011c)

Using the same groundwater categories as those described for Table 3.7-2, the acreage of lands within the total 2-mile-wide ROI corridors (and 200-foot-wide representative ROWs) of the AC collection system routes that overlie groundwater of special interest is as follows (routes not shown overlie no groundwater of special interest) (GIS Data Sources: OWRB 2011b, 2011c):

- Land area over Class 1 Special Source Groundwater: 1,003 acres (0 acres) total
    - Route E-1 in Texas and Beaver counties, Oklahoma: 967 acres (0 acres)
    - Route E-2 in Texas and Beaver counties, Oklahoma: 18 acres (0 acres)
    - Route NE-1 in Texas County, Oklahoma: 18 acres (0 acres)
- Land area over Nutrient-Vulnerable Groundwater: 27,093 acres (482 acres) total
    - Route E-1 in Texas and Beaver counties, Oklahoma: 9,893 acres (174 acres)
    - Route E-2 in Texas and Beaver counties, Oklahoma: 5,184 acres (97 acres)
    - Route E-3 in Texas and Beaver counties, Oklahoma: 5,369 acres (100 acres)
    - Route SE-1, the portion in Texas County, Oklahoma: 1,463 acres (14 acres)
    - Route SE-3, the portion in Texas and Beaver counties, Oklahoma: 5,184 acres (97 acres)

The above numbers for nutrient-vulnerable groundwater within the ROIs are large in comparison to the values shown in Table 3.7-2 for the HVDC transmission line route, primarily because of the wider ROI (2 miles) associated with the AC collection system routes. No groundwater areas of special interest underlie the AC collection system routes in Texas (TCEQ 2013), which include all or parts of AC Collection System Route SW-2 in Sherman and Hansford counties, AC Collection System Route SW-1 in Hansford County, AC Collection System Route SE-2 in Hansford County, AC Collection System Route SE-1 in Hansford and Ochiltree counties, and AC Collection System Route SE-3 in Ochiltree County.

No groundwaters of special interest are underneath the Oklahoma Converter Station Siting Area or the associated AC interconnection (GIS Data Sources: OWRB 2011b, 2011c).

3.7.5.1.3 Region 1 Wells and Wellhead Protection Areas

Because water supply wells or well systems could potentially be impacted by the Project, the affected environment for each region includes consideration of private or public water supply wells and agricultural and industrial water wells located in the ROI. The description of the affected environment also addresses areas that have been designated by the applicable state as wellhead protection areas. Oklahoma identifies three somewhat concentric zones within wellhead protection areas: a 300-foot fixed radius, a 2-year groundwater travel time boundary, and a 10-year groundwater travel time boundary. To be reasonably conservative, data analyzed for the EIS represent the total area within the boundary of the outermost zones.

Table 3.7-3 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 1 expanded ROIs (and 200-foot-wide representative ROWs plus 150-foot buffers). The table also provides the wellhead protection areas in the baseline ROIs (and 200-foot-wide representative ROWs). There are private, domestic water supply wells along the HVDC transmission line routes, but there are no public water supply wells within Region 1. The ROI for HVDC Alternative Routes 1-B and 1-C cross wellhead protection areas.

Table 3.7-3:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 1

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Total
Private (Domestic) Water Supply Wells within a 1,300-foot Corridor (and 500-foot Corridor)						
APR	0	4 (2)	0	1 (0)	2 (0)	7 (2)
With AR 1-A	0	13 (3)				13 (3)
With AR 1-B	0	4 (2)		1 (0)	2 (0)	7 (2)
With AR 1-C	0	4 (1)		1 (0)	2 (0)	7 (1)
With AR 1-D	0	4 (2)	4 (2)		2 (0)	10 (4)
Public Water Supply Wells within a 1,300-foot Corridor—No public water supply wells are within Region 1.						
Agricultural Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)						
APR	1 (0)	6 (5)	0	3 (1)	2 (2)	12 (8)
With AR 1-A	1 (0)	5 (1)				6 (1)
With AR 1-B	1 (0)	2 (1)		3 (1)	2 (2)	8 (4)
With AR 1-C	1 (0)	3 (1)		3 (1)	2 (2)	9 (4)
With AR 1-D	1 (0)	6 (5)	4 (3)		2 (2)	13 (10)
Industrial Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)						
APR	1 (1)	8 (2)	0	2 (0)	0	11 (3)
With AR 1-A	1 (1)	13 (4)				14 (5)
With AR 1-B	1 (1)	6 (2)		2 (0)	0	9 (3)
With AR 1-C	1 (1)	4 (1)		2 (0)	0	7 (2)
With AR 1-D	1 (1)	8 (2)	7 (4)		0	16 (7)
Wellhead Protection Areas within a 1,000-foot Corridor (and 200-foot ROW)						
APR (acres)	0	0	0	0	0	0
With AR 1-A (acres)	0	0				0
With AR 1-B (acres)	0	7.2 (0)		0	0	7.2 (0)
With AR 1-C (acres)	0	7.2 (0)		0	0	7.2 (0)
With AR 1-D (acres)	0	0	0		0	0

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.

2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.

GIS Data Sources: Source: ODEQ (2012), OWRB (2014)

The AC collection system routes contain the wells and wellhead protection areas shown in Table 3.7-4.

Table 3.7-4:
Water Wells within 2-Mile-Wide (and 500-Foot-Wide) Corridors and Wellhead Protection Areas within 2-Mile-Wide Corridor (and 200-Foot-Wide Representative ROWs) of the AC Collection System Routes

AC Route Designation	Number of Wells by Use Category				Total Number of Wells	Wellhead Protection Area(Acreage)
	Domestic Water Supply	Public Water Supply	Agricultural	Industrial		
E-1	15 (0)	1 (0)	23 (0)	27 (2)	66 (2)	219 (0)
E-2	21 (2)	0	56 (5)	34 (1)	111 (8)	0
E-3	21 (0)	0	39 (4)	40 (4)	100 (8)	18 (0)

Table 3.7-4:
Water Wells within 2-Mile-Wide (and 500-Foot-Wide) Corridors and Wellhead Protection Areas within 2-Mile-Wide Corridor (and 200-Foot-Wide Representative ROWs) of the AC Collection System Routes

AC Route Designation	Number of Wells by Use Category				Total Number of Wells	Wellhead Protection Area(Acreage)
	Domestic Water Supply	Public Water Supply	Agricultural	Industrial		
NE-1	25 (0)	0	124 (4)	27 (1)	176 (5)	18 (0)
NE-2	17 (2)	0	56 (2)	14 (2)	87 (6)	0
NW-1	25 (0)	0	35 (1)	28 (2)	88 (3)	0
NW-2	29 (1)	1 (0)	175 (7)	31 (0)	236 (8)	0
SE-1	10 (1)	0	52 (3)	16 (1)	78 (5)	0
SE-2	1 (0)	0	16 (0)	5 (0)	22 (0)	0
SE-3	18 (1)	0	49 (6)	20 (1)	87 (8)	0
SW-1	1 (0)	0	9 (0)	5 (0)	15 (0)	0
SW-2	10 (0)	0	15 (0)	13 (0)	38 (0)	0
W-1	18 (3)	0	38 (4)	19 (0)	75 (7)	0
Totals	211 (10)	2 (0)	687 (36)	279 (14)	1,179 (60)	255 (0)

Source: GIS Data Sources: ODEQ (2012), OWRB (2011a)

Again, the great number of wells and, to a lesser extent, the acreage of wellhead protection area are attributed to the much greater ROI width (2 miles) associated with the AC collection system routes.

No wells or wellhead protection areas are associated with the Oklahoma Converter Station Siting Area and one industrial well is located within the ROW of the AC interconnection.

3.7.5.1.4 Region 1 Groundwater Use

Groundwater and surface water uses in the counties crossed by the Region 1 ROI are summarized in Table 3.7-5. The average use of groundwater in the four-county area of Beaver, Harper, Texas, and Woodward counties in Oklahoma was about 226 million gallons per day in 2005 and the greatest share of that use, at about 79 percent, was attributed to irrigation. Livestock, public water supplies, and mining were the other notable use categories for groundwater in the four-county area. Almost 226 million gallons of groundwater were used per day as compared to only 7.4 million gallons per day of surface water. Groundwater accounts for about 97 percent of area's total water usage, and all of the area's public water supplies consist of water from groundwater sources. This use is consistent with the characterization of the area being one where intermittent streams are much more frequently encountered than are perennial streams (Section 3.15.5.1).

Table 3.7-5:
Average 2005 Water Use by Water Source and Category in Region 1 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Beaver, OK	0.43	0.22	0.32	20.62	4.39	0	1.22	0	27.20
Harper, OK	0.95	0.08	0	3.90	2.99	0	0.51	0	8.43
Texas, OK	6.06	0.22	0.04	149.08	11.47	0	6.66	0	173.53

Table 3.7-5:
Average 2005 Water Use by Water Source and Category in Region 1 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Woodward, OK	7.07	0.30	0.28	4.41	2.87	0	0.90	0.71	16.54
Subtotals	14.51	0.82	0.64	178.01	21.72	0	9.29	0.71	225.70
Surface Water Sources									
Beaver, OK	0	0	0	0.08	0	0	0	0	0.08
Harper, OK	0	0	0	6.80	0	0	0	0	6.80
Texas, OK	0	0	0	0.28	0	0	0	0	0.28
Woodward, OK	0	0	0	0.25	0	0	0	0	0.25
Subtotals	0	0	0	7.41	0	0	0	0	7.41
Totals	14.51	0.82	0.64	185.42	21.72	0	9.29	0.71	233.11

Source: USGS (2009)

Table 3.7-6 summarizes the average 2005 water use in the five-county area of Beaver and Texas counties in Oklahoma, and Hansford, Ochiltree, and Sherman counties in Texas that encompass the AC collection system routes. The predominant use of groundwater in the five-county area is even more apparent for the four-county area described above. In the five-county area, surface water use at about 1.2 million gallons per day is less than 0.4 percent of the area's total water use of 834 million gallons per day. Of the 833 million gallons per day of groundwater used in the area, irrigation is by far the predominant use category. Irrigation is followed by the use categories of livestock, mining, and public water supplies.

Table 3.7-6:
Average 2005 Water Use by Water Source and Category in the Counties of the AC Collection System Routes (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Beaver, OK	0.43	0.22	0.32	20.62	4.39	0	1.22	0	27.20
Texas, OK	6.06	0.22	0.04	149.08	11.47	0	6.66	0	173.53
Hansford, TX	0.94	0.14	0.02	205.71	3.46	0	0.60	0	210.87
Ochiltree, TX	0.07	0	0	66.28	2.59	0	0.75	0	69.69
Sherman, TX	0.57	0.13	0	344.56	6.58	0	0.17	0	352.01
Subtotals	8.07	0.71	0.38	786.25	28.49	0	9.40[1]	0	833.30
Surface Water Sources									
Beaver, OK	0	0	0	0.08	0	0	0	0	0.08
Texas, OK	0	0	0	0.28	0	0	0	0	0.28
Hansford, TX	0	0	0	0	0.57	0	0	0	0.57
Ochiltree, TX	0	0	0	0	0.13	0	0	0	0.13
Sherman, TX	0	0	0	0	0.09	0	0	0	0.09
Subtotals	0	0	0	0.36	0.79	0	0	0	1.15
Totals	8.07	0.71	0.38	786.61	29.28	0	9.40	0	834.45

1 Of the 9.40 million gallons per day, 8.96 million gallons is identified as coming from a saline groundwater source.
Source: USGS (2009)

3.7.5.2 Region 2

3.7.5.2.1 Region 2 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, no principal aquifers are present under Region 2, but the region does include two alluvial aquifers as well as an area of “other rocks,” which designates areas where there are only minor aquifers or no delineated aquifers. The western half of Region 2 overlies the North Canadian River alluvial aquifer that follows the Beaver/North Canadian River as mentioned in Section 3.7.5.1.1. This aquifer is considered a major alluvial aquifer by the state. Further to the east, Region 2 crosses over the Cimarron River alluvial aquifer that follows the Cimarron River, which the state also considers a major alluvial aquifer. The state identifies several minor alluvial and bedrock aquifers in between the two major alluvial aquifers and to the east of the Cimarron River alluvial aquifer that are crossed by the eastern half of Region 2 (GIS Data Source: OWRB 2011a).

3.7.5.2.1.1 Aquifer Annual Yield

Oklahoma has determined a maximum annual yield of 426,000 acre-feet for the section of the North Canadian alluvial aquifer that extends roughly from the western border of Harper County, through Woodward County, and to the southern border of Major County (OWRB 2014). This annual yield equates to a removal rate of about 380 million gallons per day. Based on this yield, the state developed an equal proportionate share for area landowners of 1 acre-foot of water per year per acre of land or an average daily removal rate of about 890 gallons per acre.

The state has not finalized a maximum annual yield for the Cimarron River alluvial aquifer (OWRB 2014a), but has assigned a temporary equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land (OWRB 2013a) or an average daily removal rate of about 1,790 gallons per acre.

3.7.5.2.1.2 Depths to Water Table

In the Oklahoma counties that contain Region 2, the USGS National Water Information System data collected in 2012 or later show the water table ranges from 3 to 170 feet BGS in Woodward County and ranges from 7 to 78 feet BGS in Major County. The USGS data system contained no recent (2012 or earlier) information for Garfield County, but searching the data back to 2005 shows water table depths in the county ranging from 4 to 41 feet below the surface (USGS 2014).

3.7.5.2.1.3 Groundwater Quality

Water in Oklahoma’s alluvial aquifers is generally of good quality, but in some western areas has high concentrations for chloride and sulfate and these aquifers are vulnerable to contamination from surface activities (OWRB 2012).

3.7.5.2.2 Region 2 Groundwater of Special Interest

Table 3.7-7 summarizes the acreage of land overlying groundwater of special interest in Region 2. No Class I groundwater areas occur within Region 2, but nutrient-vulnerable groundwater areas are present. Also shown in parentheses in Table 3.7-7 are the smaller land areas within the 200-foot corridor of the representative ROW that overlie groundwater of special interest.

Table 3.7-7:
Land Area in the 1,000-Foot Corridor (and the 200-Foot Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 2

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Region 2 Total
Land Area Over Oklahoma Class 1 Special Source Groundwater—No groundwater of Class 1, Subclass A or B is within Region 2				
Land Area Over Oklahoma Nutrient Vulnerable Groundwater				
APR (acres)	2,485 (494)	3,962 (780)	1,797 (361)	8,244 (1,635)
With AR 2-A (acres)	2,485 (494)	4,316 (861)	1,797 (361)	8,598 (1,716)
With AR 2-B (acres)	2,485 (494)	3,962 (780)	1,024 (206)	7,471 (1,480)

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: OWRB (2011c)

3.7.5.2.3 Region 2 Wells and Wellhead Protection Areas

Table 3.7-8 summarizes the number of private (domestic), public, agricultural, and industrial water supply wells in the Region 2 expanded ROIs and expanded representative ROWs (with 150-foot buffers added to each side). The table also provides the wellhead protection areas in the baseline ROIs (and 200-foot-wide ROWs). Public water supply wells are only found in the ROI of HVDC Alternative Route 2-A.

Table 3.7-8:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 2

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Region 2 Total
Private (Domestic) Water Supply Wells within a 1,300-foot Corridor (and 500-foot Corridor)				
APR	1 (1)	7 (1)	2 (0)	10 (2)
With AR 2-A	1 (1)	8 (2)	2 (0)	11 (3)
With AR 2-B	1 (1)	7 (1)	1 (1)	9 (3)
Public Water Supply Wells within a 1,300-foot Corridor (and 500-foot Corridor)				
APR	0	0	0	0
With AR 2-A	0	10 (2)	0	10 (2)
With AR 2-B	0	0	0	0
Agricultural Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)				
APR	0	3 (2)	4 (3)	7 (5)
With AR 2-A	0	3 (0)	4 (3)	7 (3)
With AR 2-B	0	3 (2)	3 (1)	6 (3)
Industrial Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)				
Applicant Proposed Route	3 (1)	2 (1)	1 (1)	6 (3)
With AR 2-A	3 (1)	2 (1)	1 (1)	6 (3)
With AR 2-B	3 (1)	2 (1)	0	5 (2)

Table 3.7-8:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 2

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Region 2 Total
Wellhead Protection Areas within a 1,000-foot Corridor (and 200-foot ROW)				
APR (acres)	0	0	34 (7)	34 (7)
With AR 2-A (acres)	0	116 (21)	34 (7)	150 (28)
With AR 2-B (acres)	0	0	0	0

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: ODEQ (2012) OWRB (2014)

3.7.5.2.4 Region 2 Groundwater Use

Groundwater and surface water uses in the ROI in Region 2 are summarized in Table 3.7-9. The average use of groundwater in the three-county area of Garfield, Major, and Woodward counties in Oklahoma was about 42 million gallons per day in 2005, and the largest use category was public water supplies. Irrigation, livestock, and mining were the other notable uses of groundwater in the area. The amount of surface water used in the three-county area was much less at only about 3.1 million gallons per day. Groundwater accounts for about 93 percent of area's total water usage, and all of the area's public water supplies are taken from groundwater sources.

Table 3.7-9:
Average 2005 Water Use by Water Source and Category in Region 2 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Garfield, OK	3.51	0.12	0	0.17	0.25	0	1.51	0	5.56
Major, OK	6.39	0.18	0	8.53	3.63	0	0.98	0	19.71
Woodward, OK	7.07	0.30	0.28	4.41	2.87	0	0.90	0.71	16.54
Subtotals	16.97	0.60	0.28	13.11	6.75	0	3.39	0.71	41.81
Surface Water Sources									
Garfield, OK	0	0	0	0	2.26	0	0	0	2.26
Major, OK	0	0	0	0.61	0	0	0	0	0.61
Woodward, OK	0	0	0	0.25	0	0	0	0	0.25
Subtotals	0	0	0	0.86	2.26	0	0	0	3.12
Totals	16.97	0.60	0.28	13.97	9.01	0	3.39	0.71	44.93

Source: USGS (2009)

3.7.5.3 Region 3

3.7.5.3.1 Region 3 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, Region 3 crosses over two principal aquifers. HVDC Alternative Route 3-C passes over a small portion of the Central Oklahoma aquifer and the Applicant Proposed Route crosses the Ada-Vamoosa aquifer (or Vamoosa-Ada aquifer in some references). The Central Oklahoma aquifer underlies about 2,900 square miles, entirely in Oklahoma. The aquifer consists primarily of the Garber Sandstone in the Wellington Formation and is generally designated the Gabner-Wellington aquifer by the state. This bedrock aquifer is overlain in some places by the North Canadian River and Canadian River alluvial aquifers.

The Ada-Vamoosa aquifer underlies about 2,300 miles in east-central Oklahoma and extends northward into Kansas. It consists primarily of layers of fine- to coarse-grained sandstone of the Ada and Vamoosa groups. Its maximum thickness is about 900 feet, and the aquifer is confined at its western extent, but unconfined at its eastern extent, where it is near land surface.

Figure 3.7-1 in Appendix A identifies areas of no principal aquifers with an "other rocks" designation to the west of the Central Oklahoma aquifer, to the east of the Ada-Vamoosa aquifer, and in between the two aquifer areas. The state identifies no major or minor aquifers in these areas; on a state map, they are designated as areas with "no delineated aquifer boundary" (GIS Data Source: OWRB 2011a). The very eastern end of Region 3 may be over the Arkansas River alluvial aquifer, which is considered to be a major alluvial aquifer by the state, but for purposes of this discussion, it is assumed this aquifer starts beneath the western end of Region 4 as discussed in Section 3.7.5.4.1.

3.7.5.3.1.1 Aquifer Annual Yield

The state has not finalized a maximum annual yield for the Central Oklahoma (or Garber-Wellington) aquifer (OWRB 2014), but has assigned a temporary equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land (OWRB 2013a) or an average daily removal rate of about 1,790 gallons per acre.

The state has determined a maximum annual yield of about 2.97 million acre-feet for the Oklahoma portion of the Ada-Vamoosa aquifer (OWRB 2014), which equates to a removal rate of about 2,650 million gallons per day. Based on this yield, the state developed an equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land, which equates to an average daily removal rate of about 1,790 gallons per acre.

3.7.5.3.1.2 Depths to Water Table

Depth to water in the Central Oklahoma aquifer varies from less than 100 feet to 350 feet BGS (OWRB 2012). For the Ada-Vamoosa aquifer, a 1986 study by the USGS and Oklahoma Geological Survey reported depths in Creek, Lincoln, and Payne counties ranging from 3 to 280 feet BGS (D'Lugosz et al. 1986). Of the eight Oklahoma counties that encompass Region 3, the USGS National Water Information System has very limited data as recent as 2012; in one Creek County well the depth to the water table is 37 feet BGS and in two Lincoln County wells the depth is about 100 feet BGS. Considering data in the USGS system back through 2005, depths to groundwater range from 4 to 41 feet below the ground surface in Garfield County, from 1 to 39 feet in Kingfisher County, from 3 to 140 feet in Logan County, from 12 to 36 feet in Payne County, and 130 to 160 feet in Okmulgee County. Even going back to 2005, there were no data available for Muskogee County (USGS 2014).

3.7.5.3.1.3 Groundwater Quality

Water quality in the Central Oklahoma aquifer is considered good, but nitrate is reported in some shallow portions of the aquifer and high concentrations of arsenic, chromium, and selenium can be found in some deep parts. Water quality in the Ada-Vamoosa aquifer is also considered good, but iron filtration and hardness are issues in some areas (OWRB 2013a).

3.7.5.3.2 Region 3 Groundwater of Special Interest

Table 3.7-10 summarizes the acreage of land overlying groundwater of special interest in Region 3. No Class I groundwater areas occur within Region 3, but nutrient-vulnerable groundwater areas are present. Also shown in parentheses in Table 3.7-10 are the smaller land areas of the 200-foot ROW corridor that overlie groundwater of special interest.

Table 3.7-10:
Land Area in the 1,000-Foot Corridor (and the 200-Foot Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 3

Route—Proposed and Alternatives1, 2	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Region 3 Total
Land Area Over Oklahoma Class 1 Special Source Groundwater—No groundwater of Class 1, Subclass A or B is within Region 3							
Land Area Over Oklahoma Nutrient Vulnerable Groundwater							
APR (acres)	303 (63)	55 (12)	245 (49)	698 (137)	0	0	1,301 (261)
With AR 3-A (acres)	23 (5)	55 (12)	245 (49)	698 (137)	0	0	1,039 (203)
With AR 3-B (acres)	112 (21)			698 (137)	0	0	810 (158)
With AR 3-C (acres)	303 (63)	55 (12)	651 (130)				1,009 (205)
With AR 3-D (acres)	303 (63)	55 (12)	245 (49)	698 (137)	0		1,301 (261)
With AR 3-E (acres)	303 (63)	55 (12)	245 (49)	698 (137)	0	0	1,301 (261)

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Sources: OWRB (2011b, 2011c)

3.7.5.3.3 Region 3 Wells and Wellhead Protection Areas

Table 3.7-11 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 3 expanded ROI and the expanded ROW. The table also provides the wellhead protection areas in the baseline ROIs and 200-foot-wide representative ROWs. There are many private water supply wells in the region, but no public water supply wells or industrial wells and few agricultural wells. There are also only limited wellhead protection areas in the region.

Table 3.7-11:
Water Supply Wells and Wellhead Protection Areas of the HVDC Transmission Line Routes—Region 3

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Region 3 Total
Private (Domestic) Water Supply Wells within a 1,300-foot Corridor (and 500-foot Corridor)							
APR	5 (0)	3 (0)	24 (7)	10 (5)	0	0	42 (12)
With AR 3-A	6 (1)	3 (0)	24 (7)	10 (5)	0	0	43 (13)

Table 3.7-11:
Water Supply Wells and Wellhead Protection Areas of the HVDC Transmission Line Routes—Region 3

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Region 3 Total
With AR 3-B	22 (7)			10 (5)	0	0	32 (12)
With AR 3-C	5 (0)	3 (0)	23 (7)				31 (7)
With AR 3-D	5 (0)	3 (0)	24 (7)	10 (5)	1 (0)		43 (12)
With AR 3-E	5 (0)	3 (0)	24 (7)	10 (5)	0	0	42 (12)
Public Water Supply Wells within a 1,300-foot Corridor—No public water supply wells are within Region 3.							
Agricultural Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)							
APR	0	0	0	1 (0)	0	0	1 (0)
With AR 3-A	0	0	0	1 (0)	0	0	1 (0)
With AR 3-B	0			1 (0)	0	0	1 (0)
With AR 3-C	0	0	3 (1)				3 (1)
With AR 3-D	0	0	0	1 (0)	0		1 (0)
With AR 3-E	0	0	0	1 (0)	0	0	1 (0)
Industrial Water Wells within a 1,300-foot Corridor—No industrial water wells are within Region 3.							
Wellhead Protection Areas within a 1,000-foot corridor (and 200-foot ROW)							
APR (acres)	0	0	0	0	0	0	0
With AR 3-A (acres)	0	0	0	0	0	0	0
With AR 3-B (acres)	4 (0)			0	0	0	4 (0)
With AR 3-C (acres)	0	0	53 (11)				53 (11)
With AR 3-D (acres)	0	0	0	0	0		0
With AR 3-E (acres)	0	0	0	0	0	0	0

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.

2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.

GIS Data Sources: ODEQ (2012), OWRB (2014)

3.7.5.3.4 Region 3 Groundwater Use

Groundwater and surface water uses in the ROI in Region 3 are summarized in Table 3.7-12. A shift occurs in the use of surface water in this region as compared to Regions 1 and 2. The average use of groundwater in the eight-county area of Creek, Garfield, Kingfisher, Lincoln, Logan, Muskogee, Okmulgee, and Payne counties in Oklahoma was about 56 million gallons per day in 2005, compared to about 144 million gallons per day of surface water used in the same area. Groundwater accounts for only about 28 percent of area’s total water usage. The largest use of groundwater in the eight-county area is for mining activities at 32 million gallons per day. Public water supplies, irrigation, and livestock are the other notable uses of groundwater in the area.

Table 3.7-12:
Average 2005 Water Use by Water Source and Category in Region 3 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Creek, OK	1.33	0.60	0	0	0.13	0	16.13	0	18.19
Garfield, OK	3.51	0.12	0	0.17	0.25	0	1.51	0	5.56
Kingfisher, OK	1.49	0.34	0.06	3.63	1.39	0	0.55	0	7.46
Lincoln, OK	0.37	1.50	0	0	0.26	0	5.18	0	7.31
Logan, OK	1.06	0.96	0.01	0	0.16	0	5.17	0	7.36
Muskogee, OK	0.40	0.58	0	2.66	0.26	0	0.15	0	4.05
Okmulgee, OK	0	0	0	0	0.09	0	0.81	0	0.90
Payne, OK	1.58	0.67	0	0.29	0.14	0	2.64	0	5.32
Subtotals	9.74		0.07	6.75	2.68	0	32.14	0	56.15
Surface Water Sources									
Creek, OK	4.24	0	0	0.13	1.21	0.36	0	0	5.94
Garfield, OK	0	0	0	0	2.26	0	0	0	2.26
Kingfisher, OK	0.13	0	0	0.50	2.72	0	0	0	3.35
Lincoln, OK	1.04	0	0	0.18	2.35	0	0	0	3.57
Logan, OK	1.69	0	0.34	0.32	1.49	0	0	0	3.84
Muskogee, OK	14.35	0	9.68	4.73	2.34	0	0	75.03	106.13
Okmulgee, OK	14.28	0	0	0.72	0.85	0.19	0	0	16.04
Payne, OK	1.10	0	0	0.04	1.35	0	0	0	2.49
Subtotals	36.83	0	10.02	6.62	14.57	0.55	0	75.03	143.62
Totals	46.57	4.77	10.09	13.37	17.25	0.55	32.14	75.03	199.77

Source: USGS (2009)

3.7.5.4 Region 4

3.7.5.4.1 Region 4 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, no principal aquifers underlie Region 4; rather, the figure identifies an area of “other rocks.” However, the western end of Region 4 overlies the Arkansas River alluvial aquifer that follows the Arkansas River as it traverses from northwest to southeast in this part of its reach. This aquifer is considered a major alluvial aquifer by the state. Past the Arkansas River alluvial aquifer to the east, Region 4 passes over a minor bedrock aquifer that extends to the Oklahoma-Arkansas border (GIS Data Source: OWRB 2011a).

In Arkansas, Region 4 proceeds through the Arkansas Valley. The geology of the valley has a predominance of shale and many subsurface interbeds are of similar low porosity. As a result, few rocks qualify as aquifers. Most wells in the area have poor yield (less than 10 gallons per minute), so communities rely heavily on surface water sources. The alluvium along the Arkansas River is an exception and represents a consistent source of groundwater, which is used primarily for irrigation (AGS 2014). In this area, the Arkansas River flows roughly west to east and lies to the south of the HVDC transmission line routes, also aligned in a west-east direction.

3.7.5.4.1.1 Aquifer Annual Yield

Oklahoma has not finalized a maximum annual yield for the Arkansas River alluvial aquifer (OWRB 2014a), but has assigned a temporary equal proportionate share for area landowners of 2 acre-feet of water per year per acre of land (OWRB 2013b) or an average daily removal rate of about 1,790 gallons per acre. As noted above, aquifer yield within the Region 4 area of Arkansas is low.

3.7.5.4.1.2 Depths to Water Table

The USGS National Water Information System has no recent (2012 or newer) depth to groundwater information for the Oklahoma and Arkansas counties that encompass Region 4. The query was extended to 2005 or newer and available data indicate that the water table in two of the counties (Sequoyah County, Oklahoma, and Crawford County, Arkansas) ranges from 4 to 28 feet BGS (USGS 2014). Even with the extended search timeframe, no data were available for the other four counties.

3.7.5.4.1.3 Groundwater Quality

Water in Oklahoma's alluvial aquifers, such as the Arkansas River alluvial aquifer, is generally of good quality, but it is vulnerable to contamination from surface activities (OWRB 2012). On the Arkansas side of Region 4, few rock formations produce sufficient water to qualify as aquifers (AGS 2014).

3.7.5.4.2 Region 4 Groundwater of Special Interest

Table 3.7-13 summarizes the acreage of land overlying groundwater of special interest in Region 4. Both Class I groundwater areas and nutrient-vulnerable groundwater areas are present within Region 4. The Applicant Proposed Route passes over the Oklahoma-Arkansas state line within Link 3 of Region 4. No groundwater of special interest is crossed in Links 4 through 9. The Oklahoma designations of groundwater of special interest stop at the state line; Arkansas groundwater designations of special interest are not present underneath Region 4.

The Applicant has proposed a route variation in Region 4, the Lee Creek Variation, that is not included in Table 3.7-13. The Lee Creek Variation would move a short segment, slightly more than 3 miles in length, of Link 3 of the Applicant Proposed Route less than 0.5 mile to the north in the area of the Lee Creek Reservoir, which is roughly on the Oklahoma-Arkansas border. The variation then drops back south to join the Applicant Proposed Route. Land area of the Lee Creek Variation that overlies groundwater of special interest is estimated as follows:

- Land area over Oklahoma Class 1 Special Source Groundwater: approximately 170 acres in the 1,000-foot-wide corridor and 30 acres in the 200-foot-wide ROW
- Land area over Oklahoma Nutrient-Vulnerable Groundwater: approximately 250 acres in the 1,000-foot-wide corridor and 50 acres in the 200-foot-wide ROW
- The amount land overlying groundwater of special interest within the avoided segment of the Applicant Proposed Route would be very similar to the above values

Within Arkansas, groundwaters of special interest are those areas designated by the state as "Critical Groundwater Areas." These are areas where aquifers are experiencing significant declines in water table elevations or water quality degradation (ANRC 2005). The critical designation establishes authority for the state to initiate additional regulation of the groundwater area, but to date, no additional regulations have been proposed for any of the state's designated groundwater areas (ANRC 2014). In the areas of Arkansas crossed by the HVDC transmission line routes, Region 6 traverses the Cache Critical Groundwater Area, which is described further in the Region 6 discussion (Section 3.7.5.6.2).

Table 3.7-13:
Land Area in the 1,000-Foot Corridor (and the 200-Foot Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 4

<table>
<tr><th>Route
Proposed and Alternatives[1, 2]</th><th>Link 1</th><th>Link 2</th><th>Link 3[3]</th><th>Link 4</th><th>Link 5</th><th>Link 6</th><th>Link 7</th><th>Link 8</th><th>Link 9</th><th>Region 4 Total</th></tr>
<tr><td colspan="11">Land Area Over Oklahoma Class 1 Special Source Groundwater</td></tr>
<tr><td>APR (acres)</td><td>0</td><td>0</td><td>786 (159)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>786 (159)</td></tr>
<tr><td>With AR 4-A (acres)</td><td>0</td><td>0</td><td colspan="4">1,327 (267)</td><td>0</td><td>0</td><td>0</td><td>1,327 (267)</td></tr>
<tr><td>With AR 4-B (acres)</td><td>0</td><td colspan="7">1,239 (249)</td><td>0</td><td>1,239 (249)</td></tr>
<tr><td>With AR 4-C (acres)</td><td>0</td><td>0</td><td>786 (159)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>786 (159)</td></tr>
<tr><td>With AR 4-D (acres)</td><td>0</td><td>0</td><td>786 (159)</td><td colspan="3">0</td><td>0</td><td>0</td><td>0</td><td>786 (159)</td></tr>
<tr><td>With AR 4-E (acres)</td><td>0</td><td>0</td><td>786 (159)</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0</td><td>786 (159)</td></tr>
<tr><td colspan="11">Land Area Over Oklahoma Nutrient Vulnerable Groundwater</td></tr>
<tr><td>APR (acres)</td><td>22 (4)</td><td>109 (19)</td><td>402 (76)</td><td>0[a]</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>533 (99)</td></tr>
<tr><td>With AR 4-A (acres)</td><td>22 (4)</td><td>109 (19)</td><td colspan="4">16 (0)</td><td>0</td><td>0</td><td>0</td><td>147 (23)</td></tr>
<tr><td>With AR 4-B (acres)</td><td>22 (4)</td><td colspan="7">0</td><td>0</td><td>22 (4)</td></tr>
<tr><td>With AR 4-C (acres)</td><td>22 (4)</td><td>109 (19)</td><td>402 (76)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>533 (99)</td></tr>
<tr><td>With AR 4-D (acres)</td><td>22 (4)</td><td>109 (19)</td><td>402 (76)</td><td colspan="3">0</td><td>0</td><td>0</td><td>0</td><td>533 (99)</td></tr>
<tr><td>With AR 4-E (acres)</td><td>22 (4)</td><td>109 (19)</td><td>402 (76)</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0</td><td>533 (99)</td></tr>
</table>

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
3 Link 3 of Region 4 spans Oklahoma and Arkansas, so beyond Link 3 there are no Oklahoma groundwater designations. Region 4 does not cross over specially designated groundwater in Arkansas.
GIS Data Sources: OWRB (2011b, 2011c)

3.7.5.4.3 Region 4 Wells and Wellhead Protection Areas

Table 3.7-14 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 4 expanded ROI and the expanded ROW. The table also provides the wellhead protection areas in the baseline ROIs and the 200-foot-wide representative ROWs. There are private domestic water wells along the ROI of the HVDC transmission line routes. Only a few agricultural or industrial wells are encountered by any of the route ROIs. The Lee Creek Variation, not shown in the table, would not include any wells.

Table 3.7-14:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 4

<table>
<tr><th>Route—Proposed and Alternatives[1, 2]</th><th>Link 1</th><th>Link 2</th><th>Link 3</th><th>Link 4</th><th>Link 5</th><th>Link 6</th><th>Link 7</th><th>Link 8</th><th>Link 9</th><th>Region 4 Total</th></tr>
<tr><td colspan="11">Private (Domestic) Water Supply Wells within a 1,300-foot Corridor (and 500-foot Corridor)—Number within link</td></tr>
<tr><td>APR</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>1 (0)</td><td>1 (0)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>8 (1)</td></tr>
<tr><td>With AR 4-A</td><td>0</td><td>0</td><td colspan="4">10 (5)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>15 (6)</td></tr>
<tr><td>With AR 4-B</td><td>0</td><td colspan="7">19 (12)</td><td>2 (0)</td><td>21 (12)</td></tr>
<tr><td>With AR 4-C</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>1 (0)</td><td>1 (0)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>8 (1)</td></tr>
<tr><td>With AR 4-D</td><td>0</td><td>0</td><td>1 (0)</td><td colspan="3">6 (1)</td><td>3 (1)</td><td>0</td><td>2 (0)</td><td>12 (2)</td></tr>
<tr><td>With AR 4-E</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>1 (0)</td><td>1 (0)</td><td>3 (1)</td><td colspan="2">1 (0)</td><td>7 (1)</td></tr>
<tr><td colspan="11">Public Water Supply Wells within a 1,300-foot Corridor—No public water supply wells are within Region 4.</td></tr>
<tr><td colspan="11">Agricultural Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)</td></tr>
<tr><td>APR</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>With AR 4-A</td><td>0</td><td>0</td><td colspan="4">2 (1)</td><td>0</td><td>0</td><td>0</td><td>2 (1)</td></tr>
<tr><td>With AR 4-B</td><td>0</td><td colspan="7">2 (1)</td><td>0</td><td>2 (1)</td></tr>
<tr><td>With AR 4-C</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-D</td><td>0</td><td>0</td><td>0</td><td colspan="3">0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>With AR 4-E</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="11">Industrial Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)</td></tr>
<tr><td>APR</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-A</td><td>1 (0)</td><td>0</td><td colspan="4">0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-B</td><td>1 (0)</td><td colspan="7">0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-C</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-D</td><td>1 (0)</td><td>0</td><td>0</td><td colspan="3">0</td><td>0</td><td>0</td><td>0</td><td>1 (0)</td></tr>
<tr><td>With AR 4-E</td><td>1 (0)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">0</td><td>1 (0)</td></tr>
<tr><td colspan="11">Wellhead Protection Areas within a 1,000-foot corridor—No wellhead protection areas are within Region 4</td></tr>
</table>

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.

2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.

Source: Clean Line (2013); GIS Data Sources: ODEQ (2012), OWRB (2014), AWWCC (2014),

It should be noted that the Arkansas well data included in Table 3.7-14, as well as in the corresponding tables for Regions 5, 6, and 7, came from a source (GIS Data Source: AWWCC 2014) that included a number of wells in the search area with no use designations. Wells with a blank designation were not included in the evaluations presented in this document because it was not known whether they were of possible concern if damaged, such as for the well categories shown in the table, or if they were abandoned or of some other limited value.

The only spring identified within any Project ROI is within Region 4. Dripping Spring is located just inside the 1,000-foot corridor of HVDC Alternative Route 4-D in the area where it departs from the Applicant Proposed Route in Crawford County, Arkansas.

3.7.5.4.4 Region 4 Groundwater Use

Groundwater and surface water uses in the ROI in Region 4 are summarized in Table 3.7-15. Water use in this region has shifted further in favor of surface water than described in Region 3. The average use of groundwater in the six-county area of Muskogee and Sequoyah counties in Oklahoma, and Crawford, Franklin, Johnson, and Pope counties in Arkansas, was about 8.6 million gallons per day in 2005. Conversely, surface water use was almost 1,300 million gallons per day in the same area. Groundwater accounts for only about 0.7 percent of area's total water usage. The largest use of groundwater in the six-county area is for irrigation at an average of about 4.8 million gallons per day and the second largest use category is for livestock, but it is followed closely by self-supplied domestic water use.

Table 3.7-15:
Average 2005 Water Use by Water Source and Category in Region 4 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Totals
Groundwater Sources									
Muskogee, OK	0.40	0.58	0	2.66	0.26	0	0.15	0	4.05
Sequoyah, OK	0	0.07	0	0.69	0.16	0	0	0	0.92
Crawford, AR	0	0.65	0	0.05	0.24	0	0	0	0.94
Franklin, AR	0	0	0	0	0.40	0	0	0	0.40
Johnson, AR	0	0	0	0.03	0.29	0	0	0	0.32
Pope, AR	0	0.27	0	1.34	0.38	0	0	0	1.99
Subtotals	0.40	1.57	0	4.77	1.73	0	0.15	0	8.62
Surface Water Sources									
Muskogee, OK	14.35	0	9.68	4.73	2.34	0	0	75.03	106.13
Sequoyah, OK	5.80	0	1.25	1.19	1.50	0.89	0	0	10.63
Crawford, AR	5.82	0	0.45	0.99	0.35	0	0	0	7.61
Franklin, AR	2.89	0	0	0.03	0.60	0	0	0	3.52
Johnson, AR	4.58	0	0	0	0.42	0	0	0	5.00
Pope, AR	9.58	0	0	0.61	0.57	0	0	1152.00	1162.76
Subtotals	43.02	0	11.38	7.55	5.78	0.89	0	1227.03	1295.65
Totals	43.42	1.57	11.38	12.32	7.51	0.89	0.15	1227.03	1304.27

Source: USGS (2009)

3.7.5.5 Region 5

3.7.5.5.1 Region 5 Principal Aquifers and Their Characteristics

Principal aquifers underlie Region 5 of the Project's ROI, but only at the very eastern end of the region. As shown in Figure 3.7-1 in Appendix A, the eastern end of Applicant Proposed Route in Region 5 overlies the Mississippi River Valley alluvial aquifer; all other portions of the route in this region are identified as an area of "other rocks." The largest portion of Region 5 is within the Arkansas Valley area described in Section 3.7.5.4.1, where there are few subsurface strata that yield sufficient water to qualify as aquifers. The exception is the Arkansas River alluvial aquifer, which follows the Arkansas River, although in Region 5 the river moves further away as the ROI progresses to the east.

The Mississippi River Valley alluvial aquifer at the eastern end of Region 5 is a principal aquifer that underlies about 33,000 square miles in Missouri, Kentucky, Tennessee, northwestern Mississippi, northeastern Louisiana, and eastern Arkansas. The aquifer consists primarily of a coarse sand and gravel layer that is overlain with silt, clay, and fine sand confining unit that hinders movement of water down into the aquifer. The confining unit ranges from less than 20 to more than 60 feet thick and the aquifer ranges from 25 to 150 feet thick (Renken 1998). In Arkansas, depth to the water table of the aquifer ranges from 0 to 115 feet (ANRC 2013). Wells pulling water from the Mississippi River Valley alluvial aquifer can have high yields, 500 gallons per minute is typical, some can yield 1,000 to 5,000 gallons per minute (Renken 1998).

3.7.5.5.1.1 Aquifer Annual Yield

Aquifer yields in most of Region 5 are low as was described in Section 3.7.5.4.1. The estimated sustainable yield of the Mississippi River Valley alluvial aquifer (within the state) is 2,987 million gallons per day (ARNC 2012), which equates to about 3.3 million acre-feet per year.

3.7.5.5.1.2 Depths to Water Table

The USGS National Water Information System data collected in 2012 or later include well data in three of the seven Arkansas counties that compose Region 5. The depth to the water table in the single well in Faulkner County is 6 feet BGS, the water table ranges from less than 1 to 84 feet BGS in White County and the water table ranges from 11 to 73 feet BGS in Jackson County (USGS 2014). For the other four counties, the data search was expanded to 2005 or later, but no data were available.

3.7.5.5.1.3 Groundwater Quality

Water from the Mississippi River Valley alluvial aquifer is generally of sufficient quality for most uses. Dissolved-solids concentrations are usually less than 500 milligrams per liter (the limit for esthetic qualities per 40 CFR Part 143), but in some areas, concentrations can range from 1,000 to 3,000 milligrams per liter (Renken 1998). Naturally occurring arsenic is found in some areas of the Mississippi River Valley alluvial aquifer and low concentrations (below drinking water standards) of pesticides are often detected in samples from the aquifer (EPA 2009).

3.7.5.5.2 Region 5 Groundwater of Special Interest

Region 5 of the Applicant Proposed Route crosses no Arkansas-designated critical groundwater areas.

3.7.5.5.3 Region 5 Wells and Wellhead Protection Areas

Table 3.7-16 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 5 expanded ROIs and the expanded ROWs. The table also provides the wellhead protection areas in the baseline ROIs and 200-foot-wide representative ROWs. Small numbers of private and agricultural wells are present in the region, but no public water supply wells or industrial wells. The amount of wellhead protection area in the region is also very small.

Table 3.7-16:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 5

Route Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Link 9	Region 5 Total
Private (Domestic) Water Supply Wells within a 1,300-foot Corridor (and 500-foot Corridor)										
APR	1 (0)	0	0	0	1 (0)	0	0	0	1 (1)	3 (1)
With AR 5-A	2 (1)	0	0	0	1 (0)	0	0	0	1 (1)	4 (2)
With AR 5-B	1 (0)	0	5 (2)				0	0	1 (1)	7 (3)
With AR 5-C	1 (0)	0	0	0	1 (0)	0		0	1 (1)	3 (1)
With AR 5-D	1 (0)	0	0	0	1 (0)	0	0	0	3 (2)	5 (2)
With AR 5-E	1 (0)	0	0	2 (1)			0	0	1 (1)	4 (2)
With AR 5-F	1 (0)	0	0	0	0		0	0	1 (1)	2 (1)
Public Water Supply Wells within a 1,300-foot Corridor—No public water supply wells are within Region 5.										
Agricultural Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)										
APR	0	0	0	0	0	0	0	0	3 (3)	3 (3)
With AR 5-A	0	0	0	0	0	0	0	0	3 (3)	3 (3)
With AR 5-B	0	0	3 (0)				0	0	3 (3)	6 (3)
With AR 5-C	0	0	0	0	0	0		0	3 (3)	3 (3)
With AR 5-D	0	0	0	0	0	0	0	0	0	0
With AR 5-E	0	0	0	2 (0)			0	0	3 (3)	5 (3)
With AR 5-F	0	0	0	0	0		0	0	3 (3)	3 (3)
Industrial Water Wells within a 1,300-foot Corridor—No industrial water wells are within Region 5.										
Wellhead Protection Areas within a 1,000-foot Corridor (and 200-foot ROW)										
APR (acres)	0	0	0	0	0	0	0	0	0	0
With AR 5-A (acres)	0	0	0	0	0	0	0	0	0	0
With AR 5-B (acres)	0	0	0				0	0	0	0
With AR 5-C (acres)	0	0	0	0	0	0		0	0	0
With AR 5-D (acres)	0	0	0	0	0	0	0	0	2.1[3] (0)	2.1 (0)
With AR 5-E (acres)	0	0	0	0			0	0	0	0
With AR 5-F (acres)	0	0	0	0	0		0	0	0	0

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.

2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.

3 Arkansas considers the locations of wellhead protection areas to be confidential information and as such are not shown on any figures associated with this document. The entry in this table is presented because it provides only very general location information and is of value to the analysis.

Source: Clean Line (2013); GIS Data Source: AWWCC (2014)

3.7.5.5.4 Region 5 Groundwater Use

Groundwater and surface water uses in the ROI in Region 5 are summarized in Table 3.7-17. Water use in this region is more evenly divided between groundwater and surface water than in Region 4, but surface water is the predominant source. The average use of groundwater in the seven-county area of Cleburne, Conway, Faulkner, Jackson, Pope, Van Buren, and White counties in Arkansas was almost 440 million gallons per day in 2005. Surface water use was 1,270 million gallons per day in the same area. Groundwater accounts for about 26 percent of area's total water usage. The largest use of groundwater in the six-county area is for irrigation at an average of about 429 million gallons per day. Aquaculture, public water supplies, self-supplied domestic water, and livestock are the other groundwater use categories. It should be noted that if the amount of surface water used for thermoelectric power plant cooling (Table 3.7-17) was dropped from the equation, groundwater would be the predominant source for water use in the area.

Table 3.7-17:
Average 2005 Water Use by Water Source and Category in Region 5 Counties (in million gallons per day)

County by Water Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Cleburne, AR	0.08	0.09	0	0	0.24	0	0	0	0.41
Conway, AR	0	0.18	0	1.94	0.39	0	0	0	2.51
Faulkner, AR	0.52	0.47	0	1.11	0.30	0	0	0	2.40
Jackson, AR	1.52	0.14	0	378.04	0.02	3.40	0	0	383.12
Pope, AR	0	0.27	0	1.34	0.38	0	0	0	1.99
Van Buren, AR	0	0.04	0	0.21	0.16	0	0	0	0.41
White, AR	0.75	0.73	0	46.45	0.39	0.27	0	0	48.59
Subtotals	2.87	1.92	0	429.09	1.88	3.67	0	0	439.43
Surface Water Sources									
Cleburne, AR	7.82	0	0	0	0.36	0	0	0	8.18
Conway, AR	4.00	0	7.62	4.70	0.58	0	0	0	16.90
Faulkner, AR	8.03	0	0	6.31	0.46	0	0.01	0	14.81
Jackson, AR	0	0	0	22.54	0.04	0	0	0	22.58
Pope, AR	9.58	0	0	0.61	0.57	0	0	1152.00	1162.76
Van Buren, AR	2.36	0	0	0	0.24	0	0	0	2.60
White, AR	8.27	0	0	34.03	0.59	0.04	0	0	42.93
Subtotals	40.06	0	7.62	68.19	2.84	0.04	0.01	1152.00	1270.76
Totals	42.93	1.92	7.62	497.28	4.72	3.71	0.01	1152.00	1710.19

Source: USGS (2009)

3.7.5.6 Region 6

3.7.5.6.1 Region 6 Principal Aquifers and Their Characteristics

As shown in Figure 3.7-1 in Appendix A, principal aquifers underlie all of Region 6. Most of the region is over the Mississippi River Valley alluvial aquifer, but in the central part of the region, the ROI crosses a narrow band of the Mississippi embayment aquifer system. In most areas, the Mississippi River Valley alluvial aquifer overlies the Mississippi embayment system. The Mississippi River Valley alluvial aquifer was described in Section 3.7.5.5.1. The description below focuses on the Mississippi embayment aquifer system.

The Mississippi embayment aquifer system is a system of regional aquifers, consisting primarily of semi-consolidated sand that underlies parts of Louisiana, Arkansas, Missouri, Illinois, Kentucky, Tennessee, Mississippi, Alabama, and Florida. The system comprises nine hydrogeologic units made up of six regional aquifers and three confining units, and can be up to 6,000 feet thick (Renken 1998). Within Arkansas, the state refers to the Sparta and Memphis Sands of the Mississippi embayment aquifer system as the Sparta/Memphis aquifer. Throughout the Mississippi embayment aquifer system, depth to water ranges from 37 to about 320 feet BGS (ANRC 2013). Yield from this aquifer system varies greatly depending on location and which regional aquifer is being pumped, but well production on the order of 300 to 1,000 gallons per minute are common and yields occasionally exceed 2,000 gallons per minute (Renken 1998).

3.7.5.6.1.1 Aquifer Annual Yield

As indicated in Section 3.7.5.5.1, the sustainable yield of the Mississippi River Valley alluvial aquifer (within the state) is estimated to be 2,987 million gallons per day (ANRC 2012), which equates to about 3.3 million acre-feet per year. The state estimates the sustainable yield for the Sparta/Memphis aquifer at 87 million gallons per day (ANRC 2012), which equates to about 97,500 acre-feet per year.

3.7.5.6.1.2 Depths to Water Table

The USGS National Water Information System includes 2012 or later data for all three of the Arkansas counties that compose Region 6. The depth to the water table in Jackson County ranges from 11 to 73 feet BGS, the water table ranges from 7 to 150 feet BGS in Poinsett County, and the water table ranges from 17 to 210 feet BGS in Cross County (USGS 2014).

3.7.5.6.1.3 Groundwater Quality

Water quality in the Region 6 area of the Mississippi embayment aquifer system is generally good; dissolved-solids concentrations are less than 500 milligrams per liter (Renken 1998). Groundwater quality in the Mississippi River alluvial aquifer was described in Section 3.7.5.5.1.

3.7.5.6.2 Region 6 Groundwater of Special Interest

Table 3.7-18 summarizes the acreage of land overlying Arkansas critical groundwater areas in Region 6. The feature of interest in Region 6 is the Cache Critical Groundwater Area, which is crossed by the HVDC transmission line routes in Poinsett and Cross counties. The Cache Critical Groundwater Area, however, is much larger in extent than the counties, encompassing the Mississippi River Valley alluvial aquifer and the Memphis Sand aquifer and extending into seven Arkansas counties. The critical groundwater designation is attributed to significant groundwater depletion and the associated decrease in saturated thickness has the potential to cause salt water intrusion (ANRC 2009).

Table 3.7-18:
Land Area in the 1,000-Foot Corridor (and the 200-Foot Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 6

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
Land Area Over Arkansas Critical Groundwater									
APR (acres)	0	0	64 (14)	798 (155)	236 (46)	1,519 (301)	0	0	2,617 (516)
With AR 6-A (acres)	0	711 (145)			236 (46)	1,519 (301)	0	0	2,466 (492)
With AR 6-B (acres)	0	0	70 (16)	798	236	1,519	0	0	2,623 (518)

Table 3.7-18:
Land Area in the 1,000-Foot Corridor (and the 200-Foot Representative ROW) of the HVDC Transmission Line Routes Overlying Groundwater of Special Interest—Region 6

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
				(155)	(46)	(301)			
With AR 6-C (acres)	0	0	64 (14)	798 (155)	236 (46)	1,511 (301)		0	2,609 (516)
With AR 6-D (acres)	0	0	64 (14)	798 (155)	236 (46)	1,519 (301)	0	0	2,617 (516)

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.
2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.
GIS Data Source: ANRC (2014)

3.7.5.6.3 Region 6 Wells and Wellhead Protection Areas

Table 3.7-19 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 6 expanded ROIs and the expanded ROW. The table also provides the wellhead protection areas in the baseline ROIs and 200-foot-wide representative ROWs. None of the HVDC transmission line routes in Region 6 contain private or public water supply wells or industrial water supply wells. The 1,000-foot corridors for all of the routes do, however, contain roughly the same number of agricultural wells, ranging from 28 to 31 wells. Only the ROI of HVDC Alternative Route 6-B would cross any wellhead protection areas.

Table 3.7-19:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 6

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6	Link 7	Link 8	Region 6 Total
Private (Domestic) Water Supply Wells within a 1,300-foot Corridor—No domestic water supply wells are within Region 6									
Public Water Supply Wells within a 1,300-foot Corridor—No public water supply wells are within Region 6									
Agricultural Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)									
APR	5 (2)	2 (0)	4 (1)	3 (0)	1 (0)	7 (2)	6 (3)	2 (1)	30 (9)
With AR 6-A	5 (2)		8 (2)		1 (0)	7 (2)	6 (3)	2 (1)	29 (10)
With AR 6-B	5 (2)	2 (0)	5 (2)	3 (0)	1 (0)	7 (2)	6 (3)	2 (1)	31 (10)
With AR 6-C	5 (2)	2 (0)	4 (1)	3 (0)	1 (0)	12 (6)		2 (1)	29 (10)
With AR 6-D	5 (2)	2 (0)	4 (1)	3 (0)	1 (0)	7 (2)	4 (1)	2 (1)	28 (7)
Industrial Water Wells within a 1,300-foot Corridor—No industrial water supply wells are within Region 6.									
Wellhead Protection Areas within a 1,000-foot Corridor (and 200-foot ROW)									
APR (acres)	0	0	0	0	0	0	0	0	0
With AR 6-A (acres)	0		0		0	0	0	0	0
With AR 6-B (acres)	0	0	152[3] (0)	0	0	0	0	0	152 (0)
With AR 6-C (acres)	0	0	0	0	0	0		0	0
With AR 6-D (acres)	0	0	0	0	0	0	0	0	0

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.

2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.

3 Arkansas considers the locations of wellhead protection areas to be confidential information and as such are not shown on any figures associated with this document. The entry in this table is presented because it provides only very general location information and is of value to the analysis.

Source: Clean Line (2013); GIS Data Source: AWWCC (2014)

3.7.5.6.4 Region 6 Groundwater Use

Groundwater and surface water uses in the ROI in Region 6 are summarized in Table 3.7-20. The distribution of water use in this region has shifted back to groundwater as being the predominant source. The average use of groundwater in the three-county area of Cross, Jackson, and Poinsett counties in Arkansas was 1,665 million gallons per day in 2005. About 158 million gallons per day of surface water were used in the same area. Groundwater accounts for about 91 percent of area's total water usage. Groundwater use was attributed primarily to irrigation; public water supplies and aquaculture were the other notable uses.

Table 3.7-20:
Average 2005 Water Use by Water Source and Category in Region 6 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Cross, AR	2.44	0	0.40	596.40	0.03	0.02	0	0	599.29
Jackson, AR	1.52	0.14	0	378.04	0.02	3.40	0	0	383.12
Poinsett, AR	5.12	0.16	0	672.02	0.02	4.72	0.08	0	682.12
Subtotals	9.08	0.30	0.40	1646.46	0.07	8.14	0.08	0	1664.5
Surface Water Sources									
Cross, AR	0	0	0	44.94	0.04	0.03	0	0	45.01
Jackson, AR	0	0	0	22.54	0.04	0	0	0	22.58
Poinsett, AR	0	0	0	90.36	0.03	0.09	0	0	90.48
Subtotals	0	0	0	157.84	0.11	0.12	0	0	158.07
Totals	9.08	0.30	0.40	1804.30	0.18	8.26	0.08	0	1822.6

Source: USGS (2009)

3.7.5.7 Region 7

3.7.5.7.1 Region 7 Principal Aquifers and Their Characteristics

As with Region 6, Region 7 passes over the Mississippi River Valley alluvial aquifer and the Mississippi embayment aquifer system (Figure 3.7-1 in Appendix A); the alluvial aquifer in the western and central portions of the region and the aquifer system in the eastern portion. Since both of these principal aquifers were described in the preceding discussions of Region 5 and 6 (Sections 3.7.5.5.1 and 3.7.5.6.1, respectively), the information will not be repeated here.

The eastern end of Region 7 is in Tennessee, so the information below is specific to the portion of Region 7 that is in Tennessee. Similar information for Arkansas was presented in the Region 5 and 6 discussions.

3.7.5.7.1.1 Aquifer Annual Yield

Tennessee has not yet developed estimates of sustainable yield for the aquifer underlying the eastern end of Region 7.

3.7.5.7.1.2 Depths to Water Table

The USGS National Water Information System includes 2012 or later data for both of the Arkansas counties and both of the Tennessee counties that compose Region 7. The depth to water table in Poinsett County, Arkansas, ranges from 7 to 150 feet BGS and from 7 to 54 feet BGS in Mississippi County, Arkansas. The single well in Tipton County, Tennessee, has a water table 34 feet BGS and, in Shelby County, Tennessee, the depth ranges from 11 to 170 feet BGS (USGS 2014).

3.7.5.7.1.3 Groundwater Quality

The general quality of water in the Mississippi River Valley alluvial aquifer and the Mississippi embayment aquifer system was described in Sections 3.7.5.5.1 and 3.7.5.6.1.

3.7.5.7.2 Region 7 Groundwater of Special Interest

The Applicant Proposed Route passes over the Arkansas-Tennessee state line within Link 1 of Region 7. The Arkansas portion of Region 7 of the Applicant Proposed Route crosses over no critical groundwater areas. Similarly, the Tennessee portion of Region 7 crosses over no groundwater areas designated by the state as a Special Source Water (a groundwater with exceptional quality or quantity that may serve as a valuable source for water supply or which is ecologically significant) or a Site-Specific Impaired Groundwater (one that has been contaminated by human activity and for which remediation is not reasonable or technically feasible). As indicated above, groundwater of either designation was not found within Region 7. Tennessee also uses classifications of General Use Groundwater and Unusable Groundwater, which were not considered to be of special interest for the current discussion.

3.7.5.7.3 Region 7 Wells and Wellhead Protection Areas

Table 3.7-21 summarizes the number of private, public, agricultural, and industrial water supply wells in the Region 7 expanded ROIs and the expanded ROWs. There are no wellhead protection areas in the Region 7 ROI. The ROI corridor for HVDC Alternative Route 7-D is the only one containing private domestic water supply wells and is the only one that contains no agricultural wells.

Table 3.7-21:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 7

Route—Proposed and Alternatives[1, 2]	Link 1	Link 2	Link 3	Link 4	Link 5	Region 7 Total
Private (Domestic) Water Supply Wells within a 1,300-foot Corridor (and 500-foot Corridor)						
APR	0	0	0	0	0	0
With AR 7-A	0	0	0	0	0	0
With AR 7-B	0	0	0		0	0
With AR 7-C	0	0	0			0
With AR 7-D	0	0	0	2 (0)		2
Public Water Supply Wells within a 1,300-foot Corridor—No public water supply wells are within Region 7.						

Table 3.7-21:
Water Supply Wells and Wellhead Protection Areas within the HVDC Transmission Line Routes—Region 7

<table>
<tr><th>Route—Proposed and Alternatives[1, 2]</th><th>Link 1</th><th>Link 2</th><th>Link 3</th><th>Link 4</th><th>Link 5</th><th>Region 7 Total</th></tr>
<tr><td colspan="7">Agricultural Water Wells within a 1,300-foot Corridor (and 500-foot Corridor)</td></tr>
<tr><td>APR</td><td>11 (5)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>11 (5)</td></tr>
<tr><td>With AR 7-A</td><td>18 (10)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>18 (10)</td></tr>
<tr><td>With AR 7-B</td><td>11 (5)</td><td>0</td><td colspan="2">1 (0)</td><td>0</td><td>12 (5)</td></tr>
<tr><td>With AR 7-C</td><td>11 (5)</td><td>0</td><td colspan="3">1 (0)</td><td>12 (5)</td></tr>
<tr><td>With AR 7-D</td><td>11 (5)</td><td>0</td><td>0</td><td colspan="2">0</td><td>11 (5)</td></tr>
<tr><td colspan="7">Industrial Water Wells within a 1,300-foot Corridor—No industrial water wells are within Region 7.</td></tr>
<tr><td colspan="7">Wellhead Protection Areas within a 1,000-foot corridor—No wellhead protection areas are within Region 7.</td></tr>
</table>

1 Each region of the Applicant Proposed Route (APR) is divided into links that lie between points, or nodes, where the APR is intersected by alternative routes (ARs). ARs bypass specific links of the APR as shown in the table.

2 For the ARs, the unshaded portion of the rows provides the data for the length of the AR. The shaded portion of the rows provides the data for the balance of the APR, thereby providing perspective across the region.

GIS Data Sources: AWWCC (2014), Clean Line (2013a, 2013b)

As can be seen in the table, there are no public or industrial water wells in Region 7. The table also shows no wellhead protection areas within Region 7, but in this case it is the result of insufficient information to determine any acreage values. The Millington Water Department and Naval Support Activity Mid-South in Shelby County, along with the Poplar Grove Utility District in Tipton County, are named community water systems in the Region 7 vicinity that utilize wells as water sources (TDEC 2003). Wells supplying community water systems would be associated with wellhead protection areas, but there was not sufficient location information to develop any estimates of crossing acreage. No wellhead protection areas are located within the Tennessee Converter Station Siting Area.

3.7.5.7.4 Region 7 Groundwater Use

Groundwater and surface water uses in the ROI in Region 7 are summarized in Table 3.7-22. The distribution of water use in this region again shows groundwater as the predominant source. The average use of groundwater in the four-county area of Mississippi and Poinsett counties in Arkansas, and Shelby and Tipton counties in Tennessee, was 1,184 million gallons per day in 2005. Just over 500 million gallons per day of surface water are used in the same area. Groundwater accounts for about 70 percent of area's total water usage. The largest use of groundwater in the four-county area is for irrigation at an average of 945 million gallons per day and the second largest use category is for public water supplies at 200 million gallons per day. Public water supplies in the area were identified as coming entirely from groundwater sources.

Table 3.7-22:
Average 2005 Water Use by Water Source and Category in Region 7 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Groundwater Sources									
Mississippi, AR	4.05	0	2.16	270.57	0	0.98	0	0	277.76
Poinsett, AR	5.12	0.16	0	672.02	0.02	4.72	0.08	0	682.12
Shelby, TN	187.49	0.20	29.46	1.54	0.07	0	0.32	0	219.08

Table 3.7-22:
Average 2005 Water Use by Water Source and Category in Region 7 Counties (in million gallons per day)

County Source	Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Live-stock	Aqua-culture	Mining	Thermo-electric	Row Totals
Tipton, TN	3.40	0.13	0	0.90	0.13	0	0.04	0	4.60
Subtotals	200.06	0.49	31.62	945.03	0.22	5.70	0.44	0	1183.6
Surface Water Sources									
Mississippi, AR	0	0	0	2.12	0.01	0	0	0	2.13
Poinsett, AR	0	0	0	90.36	0.03	0.09	0	0	90.48
Shelby, TN	0	0	0	0.74	0.02	0.01	0.97	405.70	407.44
Tipton, TN	0	0	0	0.90	0	0	0	0	0.90
Subtotals	0	0	0	94.12	0.06	0.10	0.97	405.70	500.95
Totals	200.60	0.49	31.62	1039.15	0.28	5.80	1.41	405.70	1684.5

Source: USGS (2009)

3.7.5.8 Connected Actions

3.7.5.8.1 Wind Energy Generation

3.7.5.8.1.1 Principal Aquifers and Their Characteristics

Wind energy generation would likely occur within WDZs. The WDZs are located within the Oklahoma and Texas panhandles that overlie the High Plains aquifer, also known as the Ogallala aquifer, as shown in Figure 3.7-1 (located in Appendix A). Portions of Zones D and J are exceptions as they fall over the area of “Other Rocks” shown in Figure 3.7-1 in Appendix A that extends across Beaver County and into Texas County along the general course of the Beaver (or North Canadian) River. Alluvial materials along the general course of the Beaver River in Beaver and Texas counties may contain usable quantities of groundwater as in the North Canadian River alluvial aquifer just to the east, but the state of Oklahoma does not consider the Beaver and Texas county portions to be a major, or even a minor alluvial aquifer (OWRB 2012). The extent and characteristics of the High Plains aquifer were described in Section 3.7.5.1.1.

As described in Section 3.7.5.1.1, the maximum annual yield of the portion of the High Plains aquifer that underlies the Oklahoma panhandle is estimated at about 2.29 million acre-feet per year. In Texas, the WDZs are located within the North Plains Groundwater Conservation District, which has set the allowable annual production for groundwater, beginning January 1, 2012, at 1.5 acre-feet per acre of land (North Plains Groundwater Conservation District 2013). Also as described in Section 3.7.5.1.1, groundwater in the portions of the High Plains aquifer north of the Canadian River, which includes all of the WDZs, is generally considered to be of good quality.

With regard to depths to the water table, the USGS National Water Information System contains groundwater level information for each of the three Oklahoma and three Texas counties that encompass the WDZs. Table 3.7-23 provides a summary of the depth to groundwater data for measurements taken since the beginning of 2012. As indicated in the table, the more shallow water tables occur in the eastern-most counties (that is, Beaver County in Oklahoma and Ochiltree County in Texas), but even in these counties, some areas have quite deep water tables.

Table 3.7-23:
Depths to Groundwater in the Oklahoma and Texas Counties with Wind Development Zones

County	Wind Development Zones within County	Groundwater Level Measurements Since 1-1-2012 in USGS Database		
		Number of Monitored Sites/Wells	Minimum Depth BGS (feet)	Maximum Depth BGS (feet)
Beaver, OK	J, K	26	16	238
Cimarron, OK	G	30	77	353
Texas, OK	D, E, F, G, H, I, J	68	94	367
Hansford, TX	A, B, C, F, L	58	39	453
Ochiltree, TX	A, K, L	42	30	479
Sherman, TX	C, F	45	229	369

Source: USGS (2014)

3.7.5.8.1.2 Groundwater of Special Interest

Groundwater areas of special interest within Oklahoma are Class I Special Source Groundwater and Nutrient Vulnerable Groundwater as described in Section 3.7.5.1.2. In Texas, groundwater areas of special interest are those designated as Priority Groundwater Management Areas. Texas uses this designation for groundwater areas experiencing, or expected to experience, critical groundwater problems. However, the three Texas counties containing WDZs have no Priority Groundwater Management Areas (TCEQ 2013). Table 3.7-24 summarizes the acreage of land overlying groundwater of special interest within the WDZs. For comparison, the table also shows the total acreage of each WDZ.

Table 3.7-24:
Wind Development Zone Acreage over Groundwater of Special Interest

Wind Development Zone	Total Acreage of Zone	Special Interest Categories	
		Acreage Over Oklahoma Class I Special Source Groundwater	Acreage Over Oklahoma Nutrient Vulnerable Groundwater
A	109,747	NA[1]	NA[1]
B	125,479	NA[1]	NA[1]
C	161,048	NA[1]	NA[1]
D	69,189	319	1,743
E	47,092	0	0
F	112,461	0	0
G	187,315	0	0
H	116,226	0	0
I	105,203	0	2,496
J	92,567	0	20,081
K	92,894	0	0
L	165,848	NA[1]	NA[1]

1. NA = Not Applicable. WDZs A, B, C, and L are located in Texas, so would not be applicable to Oklahoma groundwater designations. The three Texas counties in which WDZs A, B, C, and L are located do not contain groundwater areas with special interest designations.

GIS Data Sources: OWRB (2011b, 2011c)

As can be seen in Table 3.7-24, with the exception of Zone J, there are either no groundwater areas of special interest underlying the WDZs or they are very small in comparison to the zone's total area. With regard to Zone J, almost 22 percent of the zone's total area is over Nutrient Vulnerable Groundwater. The single area of Oklahoma Class 1 Special Source Groundwater in Zone D has a Subclass B designation for groundwater underneath lands designated by regulation (specifically, Appendix B of OAC 785.45). In this case, the designation is because of the overlying Optima Wildlife Management Area.

3.7.5.8.1.3 Wells and Wellhead Protection Areas

Table 3.7-25 summarizes the number of private (domestic), public, agricultural, and industrial water supply wells and wellhead protection areas in each of the WDZs. In the first column, the table also includes the total area of each WDZ for comparison to the wellhead protection area. As can be seen in the table, all of the zones contain relatively large numbers of wells; four of the zones (WDZs E, F, I, and K) in excess of 250 water wells each. Possibly of more significance, three of the zones (WDZs A, F, and I) each contain 8 or 9 public water supply wells. Most of the WDZs contain wellhead protection areas, but in all cases the protected areas are small in comparison to the total zone acreage.

Table 3.7-25:
Water Wells and Wellhead Protection Areas within Each of the Wind Development Zones

Wind Development Zone Number—Acreage	Number of Wells by Use Category				Total Number of Wells	Wellhead Protection Area - Acreage
	Domestic Water Supply	Public Water Supply	Agricultural	Industrial		
A—109,747	2	9	31	0	42	252
B—125-479	3	0	78	1	82	0
C—161,048	3	0	68	0	71	8
D—69,189	20	1	101	41	163	208
E—47,092	21	0	215	29	265	0
F—112,461	81	8	197	56	342	147
G—187,315	30	1	91	51	173	124
H—116,226	30	0	57	40	127	0
I—105,203	37	8	150	60	255	550
J—92,567	37	1	28	57	123	36
K—92,894	32	0	55	169	256	141
L—165,848	2	2	83	0	87	53
Totals	298	30	1,154	504	1,986	1,519

GIS Data Sources: ODEQ (2012), OWRB (2014)

3.7.5.8.1.4 Groundwater Use

Groundwater and surface water uses in the three Oklahoma counties and three Texas counties that contain WDZs are summarized in Table 3.7-26. Also shown in the table are WDZs within each of the counties, many extending across more than one county and in some cases by very small amounts (for example, the portions of Zones F and K that extend into Texas counties). The average use of water in the six-county area was about 886 million gallons per day in 2005 and the vast majority (99.8 percent) came from groundwater sources. All of the area's public and private drinking water supplies were taken from groundwater. The predominant use for water in the six-county area was irrigation with livestock watering a distant second.

Table 3.7-26:
Average 2005 Water Use by Water Source and Category in Oklahoma and Texas Counties Containing Wind Development Zones (in million gallons per day)

County Source	Wind Development Zone within County	Water Use Categories[1]						Totals
		Public Water Supply	Domestic Self-Supplied	Industrial Self-Supplied	Irrigation	Livestock	Mining	
Groundwater Sources								
Beaver, OK	J, K	0.43	0.22	0.32	20.62	4.39	1.22	27.20
Cimarron, OK	G	0.46	0.10	0	47.35	2.95	0.03	50.89
Texas, OK	D, E, F, G, H, I, J	6.06	0.22	0.04	149.08	11.47	6.66	173.53
Hansford, TX	A, B, C, F, L	0.94	0.14	0.02	205.71	3.46	0.60	210.87
Ochiltree, TX	A, K, L	0.07	0	0	66.28	2.59	0.75	69.69
Sherman, TX	C, F	0.57	0.13	0	344.56	6.58	0.17	352.01
	Subtotals	8.53	0.81	0.38	833.60	31.44	9.43	884.19
Surface Water Sources								
Beaver, OK	J, K	0	0	0	0.08	0	0	0.08
Cimarron, OK	G	0	0	0	0.25	0	0	0.25
Texas, OK	D, E, F, G, H, I, J	0	0	0	0.28	0	0	0.28
Hansford, TX	A, B, C, F, L	0	0	0	0	0.57	0	0.57
Ochiltree, TX	A, K, L	0	0	0	0	0.13	0	0.13
Sherman, TX	C, F	0	0	0	0	0.09	0	0.09
	Subtotals	0	0	0	0.61	0.79	0	1.40
Totals		8.53	0.81	0.38	834.21	32.23	9.43	885.59

1 The data source includes water use categories for aquaculture and thermoelectric power production, but there was no water use in those categories for the counties in the table.
Source: USGS (2009)

3.7.5.8.2 TVA Upgrades

As described above under Section 3.1.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.7.5.8.3 Optima Substation

The future Optima Substation would be on a 160-acre site located just east of the Oklahoma Converter Station and AC Interconnection Siting Areas. Groundwater features in the ROI for the Optima Substation would be as described in the Region 1 discussion above (Section 3.7.5.1) for the Oklahoma converter station and AC interconnection. The Optima Substation would overlie the High Plains Aquifer, the depth to groundwater in the vicinity (Texas County) is typically 94 to 370 feet BGS, no groundwater of special interest is present and no wells or wellhead protection areas are expected to be present.

3.7.6 Impacts to Groundwater

3.7.6.1 Methodology

This section addresses potential impacts to groundwater that would be expected from typical construction actions for Project components. Potential impacts to groundwater during operations and maintenance, which would be minor in comparison to those during construction, are addressed in the individual Project component discussions in Sections 3.7.6.2 and 3.7.6.3. Decommissioning impacts are also discussed by individual Project component, but are described in terms of their similarity to construction impacts. Typical construction impacts from construction activities include potential impacts related to release of contaminants directly to groundwater or that could infiltrate the ground and reach groundwater, changes to infiltration and recharge rates, effects on water availability, and physical damage to well systems as described below.

3.7.6.1.1 Potential for Groundwater Contamination

Project-related contaminants, primarily in the form of fuels and lubricants, would be present in equipment or storage containers at locations where construction activities would occur and at construction staging or storage yards. Additional potential contaminants would be associated with concrete operations, including at temporary concrete batch plants that would be needed for construction areas that are too far from commercial batch plants. In any of these locations there would be the potential for contaminants to leak, spill, or otherwise accidently release to the environment. If the released quantity were large enough and not cleaned up quickly, or if infiltrating precipitation or runoff carried the release downward, contamination could reach groundwater. If a release occurred, groundwater quality could be threatened and local agricultural or drinking water wells could become contaminated. Project-related chemicals and minerals would also come into direct contact with groundwater in instances where excavation and drilling used in foundation construction went below the water table. However, as explained further below, because of the plans and permitting requirements that the Applicant would follow when conducting construction activities and because of the non-toxic nature of relevant additives, it is unlikely that construction activities would result in contaminated groundwater.

Potential water contaminants, as well as the construction actions in which they would be used, would be managed in accordance with plans and procedures that the Applicant would be required to develop and implement. The construction would require a stormwater discharge permit under the EPA's NPDES program (Appendix C). Each of the states in which construction actions would occur has been given the authority by EPA to implement a state program. Arkansas and Tennessee implement their own state programs pursuant to this authority; Oklahoma and Texas implement their own programs except in Indian country and for specific discharges (not applicable to the Project) where EPA implements the permitting program for stormwater discharges during construction (EPA 2013). Each of these states implements its National Pollutant Discharge Elimination System (NPDES) stormwater discharge permit program through a general permit, referred to here simply as the construction general permit. Common to all of the construction general permits is the requirement for the Applicant to prepare a SWPPP, which would describe and ensure implementation of practices to reduce pollutants in stormwater discharges associated with the construction activities.

The same permit requirements that address measures to prevent stormwater contamination would act to prevent groundwater contamination because they include measures to prevent releases. These measures may include items such as using secondary containment for onsite fueling tanks or containers; providing cover, containment, and protection for chemicals, liquid products, petroleum products, and other potentially hazardous materials; using spill prevention and control measures when conducting maintenance, fueling, and repair of equipment and vehicles; and providing immediate response to any spill incident. Similarly, Clean Line would develop and follow its own SPCCP (Section 2.1.7) to minimize the potential for accidental discharge of hazardous or controlled substances. Should such a discharge occur, the elements of the SPCCP would also minimize the potential for contaminants to leave the site or reach groundwater.

Concrete operations are mentioned separately because they are common to construction actions and involve equipment carrying materials of concern in addition to fuels and lubricants. Clean Line would perform washout of concrete trucks and equipment, either at the construction site or at a temporary batch plant, at storage tanks, plastic-lined berms, or some similar containment structure. Captured liquids would not be discharged; rather, they would be allowed to evaporate or removed for disposal at an approved offsite location. Dried concrete would similarly be hauled off for proper disposal or recycling, or be broken up and used as clean fill. Clean Line may also bury hardened concrete in onsite embankments in accordance with applicable permit requirements (see Appendix F).

The deepest foundations would be those for the transmission line structures. In most instances, foundation depths for lattice structures would be 30 to 32 feet, and for pole structures, the depths would be 40 to 44 feet. Within the Mississippi floodplain, foundation depths would be greater: from 114 to 132 feet deep for lattice structures and from 83 to 94 feet deep for pole structures. Structure foundations would have to be deeper in the floodplain areas given the expected soil conditions. In the floodplain, pole structures are identified as having more shallow foundations than lattice structures because, due to engineering constraints, the Applicant would need to limit the height of poles in floodplains to 130 feet to minimize the foundation depth (Thomas 2014). Lattice structures would be used exclusively in floodplain locations requiring greater heights than 130 feet. Other than possibly in the Texas and Oklahoma panhandles, these foundation depths could reach the water table in some areas of each region of the Project. The Applicant has identified (Appendix F) two types of Project-related materials expected to come into contact with groundwater in areas where foundation construction would include work below the water table: Super Mud™ and high yield bentonite gel, both products of PDSCo. Inc. (Polymer Drilling Systems) of El Dorado, Arkansas.

Super Mud™ is described as a synthetic polymer used to create high viscosity slurries for stabilizing excavations (see Appendix F). The safety data sheet for the product provides the chemical name as anionic polyacrylamide in a water-in-oil emulsion. The only Occupational Safety & Health Administration-regulated component identified on the safety data sheet, which makes up 24 percent of the product, is "hydrotreated light petroleum distillate" (CAS No. 64742-47-8). EPA identifies this distillate as an inert material cleared for food, nonfood, and fragrance use (EPA 2014). High Yield Bentonite Gel is described as a polymer extended sodium bentonite, which is a naturally occurring clay material. It is designed for use in drilling applications and acts to stabilize the borehole walls as it circulates back to the surface, cooling the drill bit and transporting drill cuttings. The safety data sheet for this product identifies the crystalline quartz contaminants along with the nuisance dust as respirable hazards, but lists no other specific concerns. The slurries with either product would be pumped or otherwise removed from the hole prior to foundation construction, but residues would remain behind and contact with groundwater would occur during excavation or drilling. Because the materials used in these slurries do not contain contaminants of concern, impacts to groundwater would not be expected to occur.

Considering the requirements of the construction general permits, the measures that the Applicant would implement per its internal plans and procedures (Section 3.7.6.1.5), and the non-toxic nature of additives used in excavating or drilling below the water table, it is unlikely that construction activities would result in contaminated groundwater.

3.7.6.1.2 Changes to Infiltration Rates

During construction, soils at the sites of the transmission line structures and converter stations would be broken up and loosened for some period of time, either in areas of disturbed soils or in soil stockpiles, and would be expected to have lower runoff rates, and correspondingly higher infiltration rates, than before the disturbance. Higher infiltration rates would mean more water soaking into the ground that could potentially reach groundwater as recharge. At the same time, the soil in unpaved areas where heavy equipment traveled to, from, or around construction sites and in the temporary staging or storage areas could become more compacted than natural conditions and result in increased runoff and correspondingly lower infiltration rates. Conditions of loosened soil, however, would be relatively short-term and, for the most part, the disturbed areas would be restored to a pre-disturbance condition once the foundations and structures were in place. With regard to soils that may become compacted as a byproduct of equipment traffic, the Applicant would take measures to prevent serious issues such as the use of low ground pressure equipment and, as appropriate, use of temporary equipment mats. If necessary, the Applicant would also work with the landowners or tenants to determine the need for soil remediation and, as appropriate, undertake actions including decompaction, particularly in agricultural areas, to return soils to pre-disturbance conditions (Section 3.7.6.1.5). There is no evidence to suggest that the relatively small and short-term changes in infiltration rates associated with the proposed construction actions would cause noticeable changes in the area's natural groundwater recharge rates.

3.7.6.1.3 Effects on Water Availability

Adverse effects on water availability could result if the Project hindered the use of a local water well or reduced the amount of water available for other existing users. The former situation could result from the Project causing physical damage to a well or its equipment so that it was no longer operable, by taking actions such as blasting that altered local aquifer properties, or by causing contamination in a local well. As discussed further in Section 3.7.6.1.4 below, the Applicant would work with property owners or tenants to identify well locations, which would minimize the potential to inadvertently cause damage to well components, would monitor wells within 150 feet of any blasting location for changes in quality or yield, and control the use of hazardous materials. These actions would minimize the potential to release or cause contamination that could reach area wells.

Water would be needed to support construction activities, but the activities would not involve major demands for water. Water would be needed to facilitate soil compaction on access roads and at construction sites and then periodically for controlling dust on those surfaces. Slurries used in drilling and, as necessary, in stabilizing excavations would require water for their formulation. Whether mixed at commercial batch plants or at temporary portable batch plants in remote areas, water would be needed to make the concrete that would be used in foundations and for washing out concrete trucks and mixing equipment. Site restoration actions involving re-seeding or landscaping would include a water demand and some water may be required for fire prevention activities. The Applicant has considered the various construction actions that would require water and estimates the Project would require approximately 110 million gallons of water over a construction period of about 36 months (Appendix F). The Applicant would seek to obtain the water from municipal water providers along the transmission-line route where such water supplies are within a reasonable haul distance. Any other water required would be obtained through permitted sources or through supply agreements with landowners. The Applicant does not anticipate the need to drill wells to obtain water to support construction actions, but if new wells became necessary to support operational facilities, the Applicant would obtain the necessary approvals and limit withdrawal volumes so as to not adversely affect supplies for other uses (see Appendix F).

Although 110 million gallons is a substantial amount of water, when averaged over the entire construction period, it equates to about 100,000 gallons or 0.1 million gallons per day. In addition, this water demand would be spread out over a large geographic area, so the average demand of 0.1 million gallons per day would be experienced in different areas along the 700-mile route as construction progressed. Construction of the proposed converter stations, however, would be expected to cause their portions of the overall HVDC transmission line route to be associated with a higher percentage of the water demand than those sections with only transmission lines being constructed. As summarized in the average water use tables in Section 3.7.5, groundwater use varies from about 9 to 1,665 million gallons per day within the seven regions along the HVDC transmission line route. Because water for the Project is expected to come from municipal providers, its source could be groundwater or surface water depending on which part of the route is being worked. In any case, a water demand of 0.1 million gallons per day over the relatively short duration of construction is minor compared to quantities of groundwater already being used. Perennial or sustainable yields of aquifers along the route, where values are available, range from 87 to 2,987 million gallons per day, so in comparison to these numbers, the water demand of the Project represents an even smaller portion. Water demand associated with the Project is therefore not expected to have noticeable effects on groundwater resources beyond those resulting from existing water usage in Regions 1 through 7.

3.7.6.1.4 Physical Damage to Well Systems

If water wells or their associated piping systems were damaged due to construction activities, it could result in water availability issues for the local water user and breaks or other openings in the system could even provide an avenue for contamination to travel down the well and reach groundwater. Well system damage could occur as a result of direct impacts from equipment traffic or during excavations, and could also occur at locations more remote from construction if blasting was used at excavation sites. Blasting would only be used if determined to be the best way to deal with hard rock in an excavation site. The shock wave or ejected materials from blasting actions could cause damage to well systems at some distance from the excavation site.

To minimize potential impacts to wells, from either physical damage or from potential contaminants, the Applicant would work with landowners and tenants prior to construction to identify and mark locations of existing and planned wells and irrigation systems. If blasting were required within 150 feet of a spring or groundwater well, the Applicant would work with the landowner to perform preconstruction monitoring of yield and water quality and, if there was damage, would arrange for a temporary water supply until a permanent solution was identified (see EPMs in Section 3.7.6.1.5).

3.7.6.1.5 Environmental Protection Measures for Groundwater

The Applicant has developed and would adopt a comprehensive list of EPMs to avoid or minimize impacts to groundwater. Implementation of these EPMs is assumed throughout the impact analysis that follows for the Project. A complete list of EPMs for the Project is provided in Appendix F. The EPMs associated with groundwater are presented below in three general potential impact categories: (1) contamination, (2) runoff and infiltration rates, and (3) water availability, including from well system damage. Each EPM is identified by its Applicant-designated reference number.

Practices would be implemented to minimize the potential for release or mismanagement of hazardous materials that could eventually result in groundwater contamination. These EPMs include the following:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-14: Clean Line will restrict the refueling and maintenance of vehicles and the storage of fuels and hazardous chemicals within at least 100 feet from wetlands, surface waterbodies, and groundwater wells, or as otherwise required by federal, state, or local regulations.
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-31: Clean Line will provide sanitary toilets convenient to construction; these will be located greater than 100 feet from any stream or tributary or to any wetland. These facilities will be regularly serviced and maintained; waste disposal will be properly manifested. Employees will be notified of sanitation regulations and will be required to use sanitary facilities.
- W-14: Clean Line will ensure that there is no off-site discharge of wastewater from temporary batch plant sites.

Practices would be implemented to minimize changes to stormwater runoff and infiltration rates that could potentially change quantities and locations of groundwater recharge. Such EPMs would include the following:

- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easements(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-30: Clean Line will minimize the amount of time than any excavations remain open.
- AG-2: Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.

Practices would be implemented to minimize changes to existing groundwater availability, including avoiding damage to water wells and utilities. Such EPMs would include the following:

- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.

- W-5: Clean Line will construct access roads to minimize disruption of natural drainage patterns including perennial, intermittent, and ephemeral streams.
- W-11: Clean Line will locate and minimize impacts to groundwater wells and springs within the construction ROW.
- W-12: If blasting is required within 150 feet of a spring or groundwater well, Clean Line will conduct preconstruction monitoring of yield and water quality in cooperation with the landowner. In the event of damage, Clean Line will arrange for a temporary water supply through a local supplier until a permanent solution is identified.
- W-13: If any groundwater wells are needed to support operational facilities, withdrawal volumes will be limited so as not to adversely affect supplies for other uses.
- W-15: Clean Line will seek to procure water from municipal water systems where such water supplies are within a reasonable haul distance; any other water required will be obtained through permitted sources or through supply agreements with landowners.

3.7.6.2 Impacts Associated with the Applicant Proposed Project

3.7.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.7.6.2.1.1 Construction Impacts

3.7.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma converter station and the AC interconnection siting areas would be located over the High Plains aquifer, but not in an area with designations of special interest. No wells or wellhead protection area are located within the station siting area and a single industrial well is within the ROW of the AC interconnection. It is expected the well would be avoided by the transmission line, but in any case, potential impacts to wells would be minimized as described in Section 3.7.6.1. Potential impacts associated with construction of the station and AC interconnection line would be the same as those common impacts described in Section 3.7.6.1. In Texas County, where the depth to groundwater is great enough (about 94 to 370 feet BGS) that construction would not include work below the water table, work materials would not come into contact with groundwater during construction. Water needed to support construction of the converter station and AC interconnection—although expected to be obtained from a municipal provider—would likely come from groundwater, since groundwater is the predominant source of water in Texas County (Table 3.7-5). The amount of water required for construction of the converter station and AC interconnection would be spread over a couple of years and would not be expected to have an impact on the availability of groundwater for other uses.

3.7.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

The Tennessee converter station and the AC interconnection line would be located over the Mississippi embayment aquifer system, but not in an area with designations of special interest. No wellhead protection area or wells occur within the siting areas. Potential impacts associated with construction of the station and AC interconnection line would be the same as those common impacts described in Section 3.7.6.1. As shown in Table 3.7-22, surface water is used heavily in Shelby County, most for thermo-electric power plant cooling, but public water supplies in both Shelby and Tipton counties come entirely from groundwater, so water to support construction of the converter station would be expected to come from groundwater. In the limited number of monitoring wells considered, the depth to water in Tipton and Shelby counties was as shallow as about 21 feet. At this depth, construction of the converter station would not likely encounter groundwater, but transmission line structures might. If foundation construction extended below the water table, materials described in Section 3.7.6.1.1 could come into contact with groundwater. As described in that section, however, groundwater contamination would not be expected to occur.

3.7.6.2.1.2 Operations and Maintenance Impacts

Operation and maintenance of the converter stations and the AC interconnections in Oklahoma and Tennessee would not be expected to have any impacts on groundwater. No water would be needed other than the minor amount of drinking water required to support fewer than 15 full-time workers at each station; the Applicant's plans are for the stations to be connected to the municipal water system. However, the Applicant's plans also note that if a new well is required, quantities of water withdrawn would be limited so as not to adversely affect existing groundwater uses.

3.7.6.2.1.3 Decommissioning Impacts

Decommissioning of converter stations and AC interconnection lines would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact groundwater resources.

3.7.6.2.2 AC Collection System

3.7.6.2.2.1 Construction Impacts

Evaluation of the potential impacts of the AC collection system routes is based on a representative 200-foot-wide ROW for each route. Groundwater features and elements within the ROWs were presented in Section 3.7.5.1 along with the information for the 2-mile-wide ROI.

As described in Section 3.7.6.1.1, the deepest foundations for transmission line structures would be in the range of 30 to 44 feet BGS. Based on the typical depths to groundwater (Section 3.7.5.1.1.2) in the five counties in which the AC collection system routes would be located (i.e., Beaver and Texas counties in Oklahoma and Sherman, Hansford, and Ochiltree counties in Texas), it is expected that construction of foundations for transmission line structures would not reach groundwater. Accordingly, potential impacts associated with excavating or drilling to groundwater would not be applicable.

3.7.6.2.2.1.1 Route E-1

AC Collection System Route E-1 would be located over the High Plains aquifer and includes areas over groundwater of special interest. As described in Section 3.7.5.1.2, this route would be the only AC collection system route for which the ROI would cross over any notable amount of special source groundwater area (967 acres); however, the 200-foot-wide ROW would avoid the area. The E-1 ROW would be one of the five routes that cross over groundwater with the nutrient-vulnerable designation. Of the five, AC Collection System Route E-1 would encompass the largest area (174 acres), almost twice that of the next highest route. The E-1 ROW would miss the wellhead protection area that would be in the wider ROI. As shown in Table 3.7-4, the 200-foot-wide E-1 ROW would contain only two wells, both used for industrial water supplies. Potential impacts associated with construction of the AC Collection System Route E-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.2 Route E-2

AC Collection System Route E-2 would be located over the High Plains aquifer and include area with designations of special interest. As described in Section 3.7.5.1.2, the 200-foot-wide ROW of E-2 would avoid the special source groundwater area in the ROI and would be one of five system routes that cross over groundwater with the nutrient-vulnerable designation (at 97 acres), but would go over no wellhead protection area. As shown in Table 3.7-4, the E-2 ROW would contain eight wells, including two domestic water supply wells, but no public supply wells. Potential impacts associated with construction of AC Collection System Route E-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.3 Route E-3

AC Collection System Route E-3 would be located over the High Plains aquifer and include area with designations of special interest. As described in Section 3.7.5.1.2, the 200-foot-wide ROW of E-3 would be one of five routes that cross over groundwater with the nutrient-vulnerable designation (at 100 acres), but would miss the small amount of wellhead protection area in the wider ROI. As shown in Table 3.7-4, the E-3 ROW would contain eight wells, including four agricultural wells and four industrial wells. Potential impacts associated with construction of AC Collection System Route E-3 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.4 Route NE-1

AC Collection System Route NE-1 would be located over the High Plains aquifer and its 200-foot-wide ROW would be avoid the small amounts of special source groundwater and wellhead protection area that are in the wider ROI. As summarized in Table 3.7-4, the NE-1 ROW would contain no public water supply wells, but would contain five wells, including four agricultural wells and one industrial well. Potential impacts associated with construction of AC Collection System Route NE-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.5 Route NE-2

AC Collection System Route NE-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of NE-2 would contain six wells, including two domestic water supply wells, two agricultural wells, and two industrial wells. Potential impacts associated with construction of AC Collection System Route NE-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.6 Route NW-1

AC Collection System Route NW-1 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of NW-1 would contain almost three wells, including one agricultural well and two industrial wells. Potential impacts associated with construction of AC Collection System Route NW-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.7 Route NW-2

AC Collection System Route NW-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of NW-2 would contain eight wells, including one domestic water supply well and seven agricultural wells. Potential impacts associated with construction of AC Collection System Route NW-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.8 Route SE-1

AC Collection System Route SE-1 would be located over the High Plains aquifer and includes area with designations of special interest. As summarized in Section 3.7.5.1.2, the 200-foot-wide ROW of SE-1 is one of five routes that would cross over groundwater with the nutrient-vulnerable designation (at 14 acres), but would not pass through wellhead protection area. As shown in Table 3.7-4, the SE-1 ROW would contain five wells, including one domestic water supply well, three agricultural wells, and one industrial well. Potential impacts associated with construction of the AC Collection System Route SE-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.9 Route SE-2

The AC Collection System Route SE-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of SE-2 would contain no wells. Potential impacts associated with construction of AC Collection System Route SE-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.10 Route SE-3

The AC Collection System Route SE-3 would be located over the High Plains aquifer and includes area with designations of special interest. As summarized in Section 3.7.5.1.2, the 200-foot-wide ROW of SE-3 would be one of five routes that cross over groundwater with the nutrient-vulnerable designation (at 97 acres), but would not pass through wellhead protection area. As shown in Table 3.7-4, the SE-3 ROW would contain eight wells, including one domestic water supply well, six agricultural wells, and one industrial well. Potential impacts associated with construction of AC Collection System Route SE-3 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.11 Route SW-1

AC Collection System Route SW-1 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of SW-1 would contain no wells. Potential impacts associated with construction of AC Collection System Route SW-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.12 Route SW-2

AC Collection System Route SW-2 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of SW-2 would contain no wells. Potential impacts associated with construction of AC Collection System Route SW-2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.1.13 Route W-1

AC Collection System Route W-1 would be located over the High Plains aquifer, but not in an area with designations of special interest. As summarized in Table 3.7-4, the 200-foot-wide ROW of W-1 would contain seven wells, including three domestic water supply wells, the largest number of any of the route ROWs, and four agricultural wells.

Potential impacts associated with construction of AC Collection System Route W-1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.2.2 Operations and Maintenance Impacts

Operation and maintenance of AC collection system routes would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.2.2.3 Decommissioning Impacts

Decommissioning of AC collection system routes would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact groundwater resources.

3.7.6.2.3 HVDC Applicant Proposed Route

3.7.6.2.3.1 Construction Impacts

This section addresses potential impacts from construction of the HVDC transmission line within each of the seven regions. The groundwater features considered in the evaluation for each region are those located within a representative 200-foot-wide ROW for the Applicant Proposed Route. Groundwater features and elements within the ROWs were presented in the regional discussions of Section 3.7.5 along with the information for the 1,000-foot-wide ROIs. Additionally, the ROWs were expanded by 150 feet on either side, forming 500-foot corridors for use in identifying wells to account for possible physical damage from blasting (Section 3.7.6.1.4) within the ROW.

Considering the descriptions of the depth to groundwater in Sections 3.7.5.1 through 3.7.5.7, groundwater could be encountered during construction of the foundations for transmission line structures all along the Applicant Proposed Route, with the possible exception of the western and central portions of Region 1. Accordingly, the common impacts described in Section 3.7.6.1.1 that are associated with encountering groundwater during construction excavations or drilling could be applicable for each of the regions.

3.7.6.2.3.1.1 Region 1

Much of the Applicant Proposed Route in Region 1 would be located over the High Plains aquifer; the eastern end of the Applicant Proposed Route would pass over the North Canadian River alluvial aquifer. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater. As summarized in Table 3.7-2, the 200-foot-wide ROW of the Applicant Proposed Route would encompass no special source groundwater, but would overlie 570 acres of nutrient-vulnerable groundwater. As shown in Table 3.7-3, an expanded 500-foot-wide corridor for the Applicant Proposed Route would contain 11 wells, including 2 domestic water supply wells, 8 agricultural wells, and 3 industrial wells. The Applicant Proposed Route also would not pass through wellhead protection area. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.3.1.2 Region 2

The most significant aquifers along the Applicant Proposed Route in Region 2 are the North Canadian River and Cimarron River alluvial aquifers. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater. As summarized in Table 3.7-7, the 200-foot-wide ROW of the Applicant Proposed Route would encompass no special source groundwater, but would overlie 1,635 acres of nutrient-vulnerable groundwater. The Region 2 ROW would encompass only 7 acres of wellhead protection area. As shown in Table 3.7-8, the expanded ROW for the Applicant Proposed Route would contain 10 wells, including 2 domestic water supply wells, 5 agricultural wells, 3 three industrial wells. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.3.1.3 Region 3

The Applicant Proposed Route in Region 3 would pass over only one principal aquifer, the Ada-Vamoosa aquifer. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater. As summarized in Table 3.7-10, the 200-foot-wide ROW of the Applicant Proposed Route would encompass no special source groundwater, but would overlie 261 acres of nutrient-vulnerable groundwater. No wellhead protection area would be located along the Applicant Proposed Route. As shown in Table 3.7-11, the expanded ROW for the Applicant Proposed Route would contain twelve wells, all domestic water supply wells. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.3.1.4 Region 4

The western end of the Applicant Proposed Route in Region 4 would pass over the Arkansas River alluvial aquifer, but that is the only principal or major aquifer in the region. Groundwater designations of special interest along the Applicant Proposed Route are special source groundwater and nutrient-vulnerable groundwater in Oklahoma and critical groundwater area in Arkansas. As summarized in Table 3.7-13, the 200-foot-wide ROW for the Applicant Proposed Route would encompass 159 acres of special source groundwater, 99 acres of nutrient-vulnerable groundwater, and no critical groundwater area. No wellhead protection areas would be located along the Applicant Proposed Route. As shown in Table 3.7-14, the expanded ROW for the Applicant Proposed Route would contain only one well, a domestic water supply well. If the Applicant were to use the Lee Creek Variation, the route ROW would cross very similar areas of special source groundwater and nutrient-vulnerable groundwater; there would be no difference in the number of wells encountered. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.3.1.5 Region 5

The eastern end of the Applicant Proposed Route in Region 5 would pass over the Mississippi River Valley alluvial aquifer, and it is the only principal or major aquifer in the region. The groundwater designation of special interest along the Applicant Proposed Route is critical groundwater area, but there are no groundwater designations of special interest or wellhead protection area along the 200-foot-wide ROW of the Applicant Proposed Route. As shown in Table 3.7-16, the expanded ROW for the Applicant Proposed Route would contain four wells, including one domestic water supply well and three wells used for agricultural purposes. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.3.1.6 Region 6

The Applicant Proposed Route in Region 6 would traverse two principal aquifers in its path from west to east. From the west, it would cross the Mississippi River Valley alluvial aquifer, the Mississippi embayment aquifer system (crossing Crowley's Ridge in eastern Arkansas), and the Mississippi River Valley alluvial aquifer again in the east. The groundwater designation of special interest along the Applicant Proposed Route is critical groundwater area. As summarized in Table 3.7-18, the 200-foot-wide ROW of the Applicant Proposed Route would cross over 516 acres of critical groundwater area and per Table 3.7-19, would not cross wellhead protection area. Also as shown in Table 3.7-19, the expanded ROW for the Applicant Proposed Route would contain nine wells, all agricultural wells. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.3.1.7 Region 7

The Applicant Proposed Route in Region 7 would traverse two principal aquifers in its path from west to east, the Mississippi River Valley alluvial aquifer in the west and the Mississippi embayment aquifer system to the east. Groundwater designations of special interest along the Applicant Proposed Route are critical groundwater areas in Arkansas and special source water and site-specific impaired groundwater in Tennessee. No groundwater designations of special interest or wellhead protection area were identified along the Applicant Proposed Route. As shown in Table 3.7-21, the expanded ROW (i.e., a 500-foot-wide corridor) for the Applicant Proposed Route would contain 15 wells, all identified as being used for agricultural purposes. Potential impacts associated with construction of the Applicant Proposed Route would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.2.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC transmission line in Regions 1 through 7, using the Applicant Proposed Route, would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.2.3.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand primarily would be for dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be expected to be less than for construction and would not adversely impact groundwater resources.

3.7.6.3 Impacts Associated with the DOE Alternatives

3.7.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.7.6.3.1.1 Construction Impacts

The Arkansas converter station and AC interconnection siting areas would be located over an area that has no principal aquifer. This area has few subsurface strata that yield sufficient water to qualify as aquifers. No wellhead protection area or wells are present in the siting areas. Potential impacts associated with construction of the converter station and AC interconnection line would be the same as those common impacts described in Section 3.7.6.1. Surface water is the predominant source of water in both Pope and Conway counties (Table 3.7-17), where the siting areas are located, so water to support construction of the converter station and AC interconnection line would likely not come from groundwater even though it is expected to be obtained from a municipal provider. Although water depth measurements were not available for Pope and Conway counties, water tables in other portions of Region 5 of the HVDC transmission line route are often shallow, so construction actions could encounter groundwater even though the water-bearing strata may not qualify as an aquifer.

3.7.6.3.1.2 Operations and Maintenance Impacts

Operation and maintenance of the Arkansas converter station and AC interconnection line would not be expected to have any impacts on groundwater. There would be no water demand other than the minor amount of drinking water required to support fewer than 15 full-time workers and the station would be connected to the municipal water system.

3.7.6.3.1.3 Decommissioning Impacts

Decommissioning of Arkansas converter station and AC interconnection line would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be less than for construction and would not adversely impact groundwater resources.

3.7.6.3.2 HVDC Alternative Routes

3.7.6.3.2.1 Construction Impacts

This section addresses potential impacts from construction of the HVDC transmission line within the HVDC alternative routes identified for each of the same seven regions considered for the Applicant Proposed Route. The groundwater features considered in the evaluation of the HVDC alternative routes are those located within a representative 200-foot-wide ROW corridor (i.e., 100 feet on either side of the centerline of the alternative route). Groundwater features and elements within the ROWs were presented in the regional discussions of Section 3.7.5 along with the information for the 1,000 foot-wide ROIs. Additionally, the ROWs were expanded by 150 feet on either side, forming 500-foot-wide corridors for use in identifying wells to account for possible physical damage from blasting (Section 3.7.6.1.4) within the ROW.

As identified for the Applicant Proposed Route, depths to groundwater in each of the regions (Sections 3.7.5.1 through 3.7.5.7) indicate that groundwater could be encountered during construction of the foundations for transmission line structures all along the various HVDC alternative routes, with the possible exception of those in the western and central portions of Region 1. Accordingly, the common impacts described in Section 3.7.6.1.1 that are associated with encountering groundwater during construction excavations or drilling could be applicable for each of the regions.

3.7.6.3.2.1.1 Region 1

HVDC Alternative Routes 1-A through 1-D would be located largely over the High Plains aquifer and the eastern ends pass over the North Canadian River alluvial aquifer. The ROIs of HVDC alternative routes in Region 1 would encompass areas with groundwater designations of special interest and wellhead protection areas. As shown in Table 3.7-2, the 200-foot-wide ROWs of HVDC Alternative Routes 1-A, 1-B, and 1-C would cross 314, 5, and 51 more acres, respectively, of nutrient-vulnerable groundwater area than the corresponding links of the Region 1 Applicant Proposed Route, and HVDC Alternative Route 1-D would cross the same amount of area. Like the Applicant Proposed Route, none of the Region 1 HVDC alternative routes would cross wellhead protection areas. As shown in Table 3.7-3, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 1-A, 1-B, and 1-C would be fewer by four, four, and six wells, respectively, than encompassed by the corresponding links of the Region 1 Applicant Proposed Route, while the combined number of wells within the expanded ROW of HVDC Alternative Route 1-D would be eight greater than the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 1 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.1.2 Region 2

The most significant aquifers along the Region 2 HVDC alternative routes are the North Canadian River and Cimarron River alluvial aquifers. As summarized in Tables 3.7-7 and 3.7-8, the HVDC alternative routes in Region 2 would encompass areas with two groundwater designations of special interest: nutrient-vulnerable groundwater and wellhead protection area. The 200-foot-wide ROW of HVDC Alternative Route 2-A would cross 81 more acres of nutrient-vulnerable groundwater than the corresponding links of the Region 2 Applicant Proposed Route, while 2-B would cross 155 fewer acres. With respect to well head protection area, the ROW of HVDC Alternative Route 2-A would cross 21 more acres than the corresponding links of the Applicant Proposed Route and 2-B would cross none compared to 7 acres by the Applicant Proposed Route. As shown in Table 3.7-8, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROW of HVDC Alternative Route 2-A would be one more than encompassed by the corresponding links of the Region 2 Applicant Proposed Route, while the total number of wells within the expanded ROW of HVDC Alternative Route 2-B would be two less. Of note in these numbers, HVDC Alternative Route 2-A would encompass two public water supplies wells compared to none in the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of any of the HVDC alternative routes in Region 2 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.1.3 Region 3

The HVDC alternative routes in Region 3 would pass over the principal aquifer, the Ada-Vamoosa aquifer, and HVDC Alternative Route 3-C also would pass over the edge of a second principal aquifer, the Central Oklahoma aquifer. As summarized in Tables 3.7-10 and 3.7-11, the HVDC alternative routes in Region 3 would encompass areas with two groundwater designations of special interest: nutrient-vulnerable groundwater and wellhead protection area. As shown in Table 3.7-10, the 200-foot-wide ROWs of HVDC Alternative Routes 3-A, 3-B, and 3-C would cross 58, 103, and 56 fewer acres, respectively, of nutrient-vulnerable groundwater area than the corresponding links of the Region 3 Applicant Proposed Route, and HVDC Alternative Routes 3-D and 3-E would cross the same amount of area. With respect to wellhead protection area, the ROW of HVDC Alternative Route 3-C would cross 11 acres while the ROWs of the other HVDC alternative routes as well as the Applicant Proposed Route would encompass none. As shown in Table 3.7-11, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROW of HVDC Alternative Route 3-A would be one more than encompassed by the corresponding links of the Region 3 Applicant Proposed Route, while the total number of wells within the expanded ROW of HVDC Alternative Route 3-C would be four less; the expanded ROWs of HVDC Alternative Routes 3-B, 3-D, and 3-E would be the same as the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative routes in Region 3 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.1.4 Region 4

The only principal or major aquifer passed over by the HVDC alternative routes in Region 4 would be the Arkansas River alluvial aquifer. As summarized in Table 3.7-13, groundwater designations of special interest along the Region 4 HVDC alternative routes are special source groundwater and nutrient-vulnerable groundwater. The 200-foot-wide ROWs of HVDC Alternative Routes 4-A and 4-B would cross 108 and 90 more acres, respectively, of special source groundwater than the corresponding links of the Region 4 Applicant Proposed Route. With respect to nutrient-vulnerable groundwater, the ROWs of HVDC Alternative Routes 4-A and 4-B would cross no designated areas, but the corresponding links of the Applicant Proposed Route would cross 76 and 95 acres, respectively. The ROWs of HVDC Alternative Routes 4-C, 4-D, and 4-E, being in Arkansas, would cross no area of special source groundwater or nutrient-vulnerable groundwater just as the corresponding links of the Applicant Proposed Route would cross none. As shown in Table 3.7-14, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 4-A, 4-B, and 4-D would be more by 6, 12, and 1, respectively, than encompassed by the corresponding links of the Region 4 Applicant Proposed Route. No wells would be within the expanded ROW of HVDC Alternative Routes 4-C and 4-E, just as there would be no wells in corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 4 would be the same as those common impacts described in Section 3.7.6.1.

HVDC Alternative Route 4-B passes through national forest land. The greater amount of special source groundwater and number of wells that would be encompassed by this alternative route, as compared to the corresponding links of the Applicant Proposed Route, might be considered to represent more potential for environment impact. However, the potential would still remain low.

3.7.6.3.2.1.5 Region 5

The eastern end of the HVDC alternative routes in Region 5 would pass over the Mississippi River Valley alluvial aquifer, the only principal or major aquifer in the region. No groundwater designations of special interest are present along HVDC alternative routes in Region 5 and the 200-foot ROWs of all alternative routes avoid wellhead protection area. As shown in Table 3.7-16, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 5-A, 5-B, and 5-E would be more by one, two, and one, respectively, than the number of wells in the corresponding links of the Region 5 Applicant Proposed Route.

The ROWs of HVDC Alternative Routes 5-C and 5-F would contain the same number of wells as the corresponding links of the Applicant Proposed Route, and the ROW of HVDC Alternative Route 5-D would contain two fewer wells than the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 5 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.1.6 Region 6

The HVDC alternative routes in Region 6 would traverse two principal aquifers in their paths from west to east. From the west, they would cross the Mississippi River Valley alluvial aquifer, the Mississippi embayment aquifer system (crossing Crowley's Ridge in eastern Arkansas), and the Mississippi River Valley alluvial aquifer again in the east. The only groundwater designation of special interest along the HVDC alternative routes in Region 6 is critical groundwater area. As shown in Table 3.7-18, the 200-foot-wide ROW of HVDC Alternative Route 6-A would cross 24 fewer acres of critical groundwater area than the corresponding links of the Region 6 Applicant Proposed Route, and HVDC Alternative Route 6-B would cross 2 more acres than the corresponding links of the Applicant Proposed Route. The ROWs of HVDC Alternative Routes 6-C and 6-D would cross the same amount of designated area as the corresponding links of the Applicant Proposed Route. The 200-foot ROWs of all alternative routes avoid wellhead protection area. As shown in Table 3.7-19, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROWs of HVDC Alternative Routes 6-A, 6-B, and 6-C would each be one more well than encompassed by the corresponding links of the Region 6 Applicant Proposed Route, while the total number of wells within the expanded ROW of HVDC Alternative Route 6-D would be two less. Potential impacts associated with construction of an HVDC alternative route in Region 6 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.1.7 Region 7

The HVDC alternative routes in Region 7 would traverse two principal aquifers in their path from west to east, the Mississippi River Valley alluvial aquifer in the west and the Mississippi embayment aquifer system to the east. Like the Applicant Proposed Route, no groundwater designations of special interest—or wellhead protection area—are identified along the Region 7 HVDC alternative routes. As shown in Table 3.7-21, the combined number of wells (domestic, agricultural, and industrial) encompassed by the expanded (500-foot-wide) ROW of HVDC Alternative Route 7-A would be five more than encompassed by the corresponding links of the Region 7 Applicant Proposed Route and they are all agricultural wells. There are no wells in the expanded ROWs of HVDC Alternative Routes 7-B, 7-C, and 7-D, the same as for the corresponding links of the Applicant Proposed Route. Potential impacts associated with construction of an HVDC alternative route in Region 7 would be the same as those common impacts described in Section 3.7.6.1.

3.7.6.3.2.2 Operations and Maintenance Impacts

Operation and maintenance of an HVDC transmission line in Regions 1 through 7, using any of the HVDC alternative routes, would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.3.2.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines, with the Applicant Proposed Route or any of the HVDC alternative routes, would be expected to have impacts similar to those described in Section 3.7.6.1 for common construction activities, i.e., the same types of measures would be required to manage the fuel and lubricants that would be present in equipment and actions to protect stormwater runoff at the site would ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to that needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be expected to be less than for construction and would not adversely impact groundwater resources.

3.7.6.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs that would avoid and minimize impacts to groundwater. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would minimize the potential for release or mismanagement of hazardous materials, changes to stormwater runoff and infiltration rates, and changes to existing groundwater availability are identified in Section 3.7.6.1.5. The EPMs are sufficiently comprehensive to minimize or avoid potential adverse impacts to groundwater. The DOE has therefore not identified any additional groundwater-related best management practices.

3.7.6.5 Unavoidable Adverse Impacts

Standard construction practices along with the EPMs to which the Applicant has committed (Section 3.7.6.1.5) should avoid adverse impacts to groundwater with the exception that water resources would be required to support the construction. Although the water needed for the Project is expected to come from municipal water systems, some of that municipal water would undoubtedly come from groundwater sources. To the extent that groundwater resources are replenished by cyclic, seasonal recharge, adverse impacts would be small and relatively short-term, but there would be a minor reduction in groundwater available for other uses or natural features while the construction took place.

As described in Section 3.7.6.1.1, common materials present during construction would be considered groundwater contaminants were those materials to be spilled, leaked, or otherwise released and eventually reach groundwater. The potential for groundwater quality problems is minor because measures required by permits as well as the additional measures that would be implemented by the Applicant (i.e., the EPMs of Section 3.7.1.6.5) would ensure proper management of such materials and appropriate responses to any releases should they occur, but the potential would not be eliminated.

Water (some likely from groundwater sources) would also be needed to support operations and maintenance of the transmission lines and converter stations, but the quantities would be minor in comparison to quantities currently used in the region.

3.7.6.6 Irreversible and Irretrievable Commitment of Resources

The Project would involve a commitment of groundwater resources, but at least to some extent, those resources would be replenished by cyclic seasonal recharge. The commitment of groundwater resources would be irreversible in that it would limit, in the short term, other options for use of that resource. Over time, however, the amounts of groundwater used to support construction would be expected to have a negligible effect on groundwater resources.

In sum, the groundwater resource would be renewable or recoverable, so the commitment would not be considered irretrievable.

3.7.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Groundwater required to support the Project would represent a new, short-term use of the resource, but would have negligible effect on its long-term productivity.

3.7.6.8 Impacts from Connected Actions

3.7.6.8.1 Wind Energy Generation

3.7.6.8.1.1 Construction Impacts

Construction of wind farms in the Oklahoma and Texas panhandle areas would be expected to involve potential impacts to groundwater similar to those described in Section 3.7.6.1 for common construction activities under the Project. Sources of contamination, primarily in the form of fuels and lubricants, would be present at construction sites and at associated construction staging and storage yards. Soils in construction areas, access routes, and support areas would be disturbed and, for at least some period of time, would be expected to experience changes in stormwater infiltration and runoff rates as compared to undisturbed conditions. Water needs to support construction activities could affect the availability of groundwater resources for other users in the region. The construction actions could also affect local groundwater availability by causing damage to existing wells or piping systems.

The groundwater features that could be affected by construction or that could alter construction approaches due to added requirements are presented in Section 3.7.5.8.1 by WDZ. Although there are differences in groundwater features between the WDZs, DOE has no way of predicting precisely where wind farms might be constructed within the WDZs and therefore cannot address whether those features would be of concern to a specific wind farm proposal. Further, it is estimated that future wind farm developments utilizing the Applicant's transmission line would include only 20 to 30 percent of any WDZ (Clean Line 2014) and the nature of wind farm developments is that large areas are required, but only relatively small areas are physically impacted. As a result, wind farm design would be expected to have flexibility on where roads and facilities were placed and what locations, specifically those with environmental concerns, could be avoided. Because of these factors, DOE has not identified potential groundwater impacts for individual WDZs; rather the discussion that follows provides more detail on the typical impacts that would be expected from the construction of wind farms within any of the WDZs.

3.7.6.8.1.1.1 Potential for Groundwater Contamination

Construction of even one large wind turbine would involve land disturbance of more than 1 acre (BLM 2005), which is the trigger in both Oklahoma and Texas for requiring a construction general permit for stormwater discharges under the EPA NPDES program as implemented by each state. Accordingly, construction of a wind farm in either state would be subject to the requirements of a construction general permit and the standard permit provisions described in Section 3.7.6.1.1. The future wind farm developer would be required to prepare and implement a SWPPP, which would in turn act to prevent groundwater contamination by requiring actions to prevent contaminant releases. If wind farm construction required setup of a temporary concrete batch plant, its operation would also be subject to permit requirements. Since wind farm developments require relatively small amounts of permanently disturbed or dedicated land (or restated, large areas of land remain unused between individual wind turbines) (Denholm et al. 2009), it is typical for them to be located on private land under lease agreements with landowners. Since some type of formal agreement with landowners would be expected, it is unlikely that wind farm construction would take place without knowing the exact locations of existing features such as wells that are important to the landowner. It is reasonable to assume that any actions that might damage or contaminate any wells (and groundwater) would be avoided.

Wind farm construction activities could involve foundation depths up to 40 feet if pier foundations are used, but the often-used mat foundations, while requiring more land area, generally do not require excavations of more than 10 feet in depth (DOE 2013). As shown by the water table depths in Table 3.7-23, construction of pier foundations in WDZs in Beaver County, Oklahoma, or in Ochiltree County, Texas (i.e., WDZ-A, -J, -K, and -L), could encounter groundwater, but in the other counties, construction would be unlikely to reach groundwater. Construction of mat foundations would be unlikely to encounter groundwater in any of the WDZs. As described in Section 3.7.6.1.1 for the Project, if foundations for wind turbines or other facilities involve excavations or drillings that reach groundwater, materials such as drilling muds or bentonite could be used to help stabilize excavation or borehole walls. Although they would come into contact with groundwater, these materials are formulated to be relatively immobile in groundwater (they adhere to and stabilize soil surfaces), are non-toxic, and would be used for their intended purposes.

With the wind farm development elements described above, it is expected that construction of the connected action would involve the same minor potential for groundwater contamination impacts as described in Section 3.7.6.1.1 for general construction under the Project.

3.7.6.8.1.1.2 Changes to Infiltration Rates

As described in Section 3.7.6.1.2 for the Project, soils at connected action construction sites would be broken up, loosened, and stockpiled for some period of time during which such soils would have higher infiltration rates, possibly with higher groundwater recharge, than undisturbed soils. Similarly, soil in some areas could be compacted intentionally to improve its stability or indirectly through equipment traffic and have lower infiltration rates as a result. However, such conditions would be expected to be relatively short-term, with most soils being restored to a pre-disturbance condition once foundations and structures were in place. Also, areas of permanent or long-term disturbance would be relatively small compared to surrounding areas not disturbed by the connected action; it is estimated that the footprint of all wind farm facilities and structures, including maintained access roads, would be approximately 1 percent of the total wind farm area (Denholm et al. 2009). The relatively small and short-term changes in infiltration rates would not be expected to result in any noticeable changes in the area's natural groundwater recharge rates.

3.7.6.8.1.1.3 Effects on Water Availability

Water would be needed to support construction of the connected action wind farms. As shown in Table 3.7-26, the majority of water used in the six-county area of the WDZs comes from groundwater. Accordingly, it is assumed that whatever water is needed to support construction of the connected action wind farms would be from groundwater sources. Primary water needs would include use for soil compaction during road, substation, and wind turbine foundation construction; as a component of concrete; and for dust suppression.

The BLM (2010) estimated that 9.8 million gallons of water would be required over an 8-month construction period for a typical wind farm of 34 to 52 wind turbines, each with a capacity of 3MW. For the current evaluation, it is conservatively assumed that this would be the water demand for 34 such wind turbines, which equates to a construction water demand of 96,000 gallons/MW of wind farm generating capacity. The Applicant assumes that the total capacity of the wind farms in the WDZs would have to be 4,000 to 4,550MW to achieve the Project's full utilization of 3,500 to 4,000MW. The Applicant also assumes that 90 percent of this total capacity can be constructed in a 2-year time frame leading up to the operation date of the Project, with the remaining 10 percent constructed in the following year (Clean Line 2014). At 90 percent of 4,550MW and an estimated construction water demand of 96,000 gallons/MW, it is estimated that 363 million gallons of water would be needed during 2 years of peak wind farm construction, or an average water demand of 0.54 million gallons per day during the 2-year period.

The Applicant estimates the maximum wind development for the individual WDZs ranges from a minimum of 300MW (for WDZ-D and WDZ-E) to a maximum of 1,300MW (for WDZ-G). To construct wind farms with a combined capacity of 4,095MW (i.e., 90 percent of 4,550MW) in two years, it is clear that the estimated water demand of 0.54 million gallons per day would be spread out over multiple WDZs. At any given time, the water demand could be focused in a small number of the zones, but over time the average demand in any single zone would be expected to be only a fraction of the 0.54 million gallons per day. Although a notable amount of water, 0.54 million gallons per day is only 0.06 percent of the 886 million gallons per day (Table 3.7-26) used in the six-county area in which the WDZs are located. On a county-by-county basis, however, 0.54 million gallons per day represents as much as 2.0 percent of a county's water use (in the case of Beaver County, Oklahoma). As noted above, however, over the two-year construction period, the total water demand would have to be spread out over multiple WDZs and multiple counties.

Since groundwater is the predominant source of water used in the six-county region of the WDZs (Table 3.7-26), it is assumed that water to support construction of the connected action wind farms would be obtained from new wells or, more likely, from existing wells and existing water rights holders. Irrigation is the predominant water use in all six counties (Table 3.7-26) and there are large numbers of agricultural wells in each of the WDZs (Table 3.7-25). It seems less likely that any significant portion of the water demand would be obtained from public water systems because the public water systems in all six counties produce less than 9 million gallons per day, with three of the counties producing less than 0.5 million gallons per day each. It is important to note that the water needed to support the primary construction demands would not have to be of drinking water quality.

3.7.6.8.1.2 Operations and Maintenance Impacts

Operations and maintenance of wind farm facilities in any of the WDZs would not impact groundwater. During operations and maintenance, no notable sources of contaminants would be in use other than the typical fuels and lubricants found in vehicles and equipment, no soil disturbance would occur, and water needs would be limited to personal needs of the few workers that would be associated with maintenance of facilities and equipment.

3.7.6.8.1.3 Decommissioning Impacts

Decommissioning of wind farms would be expected to have impacts similar to those described in Section 3.7.6.8.1 and in more detail in Section 3.7.6.1 for common construction activities. Measures would be required to manage the fuel and lubricants that would be present in equipment and actions would be taken to protect stormwater runoff at the site to ensure that contaminants did not reach groundwater. Water demand during decommissioning would be limited to the amounts needed for actions such as dust suppression, soil compaction, and possibly re-seeding or landscaping to put the ground back into suitable condition. Water demand would be expected to be less than for construction and would not adversely impact groundwater resources.

3.7.6.8.2 Optima Substation

Groundwater impacts from construction of the Optima Substation would be the same as described in Section 3.7.6.2.1 for the Oklahoma converter station and AC interconnection and the common construction impacts described in Section 3.7.6.1. Depths to groundwater are great enough that it is unlikely that groundwater would be reached during excavation for the substation's foundation. Impacts during operations and maintenance would be expected to be similar to those described for the Oklahoma converter station and AC interconnection in Section 3.7.6.2.1.

3.7.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow. In general, the upgrades are expected to occur in western and middle Tennessee and include construction of new transmission line as well as modifications to existing facilities (substations and transmission lines).

Groundwater impacts of concern for the required TVA upgrades, like the Project, are associated with the potential for groundwater contamination, changes to infiltration rates, effects on water availability, and physical damage to well systems. These concerns would be limited primarily to construction activities associated with the new transmission line. The TVA upgrades would not be expected to use large quantities of water during long-term operations.

The new transmission line would be expected to involve the presence of the same type of potential contaminants (primarily fuels and lubricants in equipment) during construction and to implement the same type of measures to ensure those contaminants were not released. The construction would be expected to involve relatively minor changes to infiltration rates and, to minimize potential liability, TVA would take precautions to ensure that equipment movement and excavations did not unknowingly damage well systems. Water needs for dust suppression, soil compaction, equipment cleaning, and concrete formulation would be relatively minor and short term. There would be little potential for impacts to groundwater during upgrades involving modifications to existing facilities. A possible exception would be if replacement of structures was required as part of the upgrades to existing transmission lines. These type activities could involve new ground disturbances and potential for impacts to groundwater similar to those described for typical construction.

3.7.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not move forward. Groundwater conditions would remain as described in the affected environment descriptions of Section 3.7.5.

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Tables

3.8 Health, Safety, and Intentional Destructive Acts

This section presents the results of DOE's analysis of potential health and safety impacts associated with the Project. Some additional health and safety concerns regarding members of the public are addressed in individual resource area discussions elsewhere in this EIS including electrical environment (Section 3.4), surface and subsurface instability (Section 3.6), noise (Section 3.11), surface water resources (Section 3.15), and transportation (Section 3.16).

3.8.1 Regulatory Background

3.8.1.1 Federal Requirements

Transmission line projects must be designed to meet or exceed applicable safety and reliability criteria and requirements outlined by organizations and standards such as NERC, the National Electrical Safety Code (NESC), the Southwest Power Pool, TVA, the American Society of Chemical Engineers, and other applicable federal, state, or local requirements. Appendix B of the NESC contains detailed requirements to ensure the safe design, construction, and operations and maintenance of transmission line projects. The NESC is published by the IEEE (IEEE 2011). Worker safety during construction and operations is regulated by workplace safety rules established by the Occupational Safety and Health Administration (OSHA) and/or equivalent workplace safety rules established by each state (Clean Line 2013a). The OSHA standards and NESC rules work together to create a comprehensive set of standards and practices designed to protect the health and safety of workers engaged in the construction, operations, and maintenance of a project. Industrial construction and routine workplace operations are governed by the Occupational Safety and Health Act of 1970, specifically 29 CFR Part 1910 (general industry standards) and 29 CFR Part 1926 (construction industry standards).

EO 13045, Protection of Children from Environmental Health Risks and Safety Risks (62 FR 19885, April 23, 1997), dictates that each federal agency ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health or safety risks; children are defined as populations under the age of 18. This EO is relevant if it is determined that there may be disproportionate health and safety impacts to children from construction or operations and maintenance of the Project.

Management of hazardous waste is governed by RCRA, which establishes a program administered by the EPA that regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. Section 3.8.4.1 identifies the hazardous materials that could be used and the potential hazardous waste that could be generated on the Project. Title III of the Superfund Amendments and Reauthorization Act also known as the Emergency Planning and Community Right-to-Know Act requires states to promote outreach for developing local emergency preparedness programs to respond to chemical releases, receive reports from the regulated community, and to analyze and disseminate the resulting information on hazardous chemicals to local governments and the public.

Security of the components of the Project facilities can involve a variety of different regulatory and reporting structures, authorities, and agencies. Intentional destructive acts, sabotage, vandalism, theft, or other mischief, whether from terrorist activities or other criminal behavior, would be addressed through law enforcement and Project design protocols.

Presidential Policy Directive 21, "Critical Infrastructure Security and Resilience," identifies 16 critical infrastructure sectors, including energy, and identifies the national goal to advance a national policy to strengthen and maintain secure, functioning, and resilient critical infrastructure. This Project would fall under the energy sector's definition of critical infrastructure. This directive includes measures that address public-private partnerships to reduce vulnerability and guidelines to address vulnerability, and the directive establishes federal government roles and responsibilities for protecting critical infrastructure.

The NERC is a not-for-profit entity whose mission is to ensure the reliability of the bulk-power system in North America. The NERC develops and enforces reliability standards; assesses seasonal and long-term reliability; monitors the bulk-power system through system awareness; and educates, trains, and certifies industry personnel. The NERC's reliability standards include requirements for physical and cyber security of bulk-power system facilities, including major transmission lines (NERC 2014). In November 2013, the Federal Energy Regulatory Commission issued Order Number 791 (FERC 2013), approving Version 5 Critical Infrastructure Protection Reliability Standards submitted for approval by the NERC. There are 10 reliability standards that require certain users, owners, and operators of the bulk-power system to comply with specific requirements to safeguard critical cyber assets. In the area of security, the NERC reliability standards have focused on cyber security for operational systems; however, related requirements apply to security risk assessment and physical security and protection of critical facilities.

The U.S. Department of Homeland Security Homeland Infrastructure Threat and Risk Analysis Center, which conducts integrated threat analysis for all critical infrastructure and key resources, works in partnership with owners and operators and other federal, state, and local government agencies to ensure that suitable threat information is made available (DHS 2010).

3.8.1.2 State Requirements

State health and safety requirements are designed to be generally consistent with the federal requirements to ensure comparable standards for the workplace. Workplace health and safety requirements for Oklahoma, Arkansas, Tennessee, and Texas are summarized in Table 3.8-1. Although Oklahoma, Arkansas, and Tennessee have adopted the federal OSHA requirements, some exceptions may apply in cases where further information or more stringent requirements were deemed necessary by the state; exceptions are identified within each state's OSHA program.

Table 3.8-1:
State Occupational Health and Safety Information

State	Workplace Health and Safety Authority	Responsible State Agency	Additional Information
Oklahoma	Oklahoma Occupational Health and Safety Standards Act, codified in the Oklahoma Statutes, Title 40, Sec. 401, et seq.	Oklahoma Department of Labor; OSHA, Consultation Division	The state has adopted the U.S. Department of Labor OSHA health and safety standards
Arkansas	Arkansas Department of Labor Safety Code 11 on Electrical Safety	Arkansas Department of Labor, Occupational Safety and Health Division	The state has adopted the U.S. Department of Labor OSHA health and safety standards
Tennessee	Tennessee Occupational Safety and Health Act of 1972 as codified in Tennessee Code Annotated Sec. 50-3-101 through 50-3-919	Tennessee Occupational Health and Safety Administration	The state has adopted the U.S. Department of Labor OSHA health and safety standards
Texas	No comprehensive workplace health and safety legislation	Texas Department of Insurance, Division of Workers Compensation	Texas does not have its own occupational health and safety regulatory program, but all private-sector workplaces must comply with federal OSHA regulations

Source: Clean Line (2013a)

The ODEQ manages hazardous waste in Oklahoma under the Oklahoma Hazardous Waste Management Act (27A Oklahoma Statutes Sec. 2-7-101 et seq.), which applies to construction and operations and maintenance activities. The Oklahoma Emergency Response Act (27A Oklahoma Statutes Sec. 4-2-102) governs emergency response to hazardous material incidents that may present a threat to public health and safety throughout the state. This act applies in the event of a release of a hazardous material caused by construction, operations, or decommissioning activities in Oklahoma. Oklahoma's Emergency Planning and Community Right-to-Know regulation (Oklahoma Administrative Code 252-020) requires reporting for the use or generation of hazardous chemicals. Projects that include handling of hazardous chemicals during construction or operations and maintenance and that meet regulatory thresholds would require reporting under this regulation.

Under the Arkansas Hazardous Waste Management Act (Arkansas Code, Sec. 8-7 202 et seq.), the Arkansas State Hazardous Waste Division manages hazardous waste in Arkansas through the state's RCRA Subtitle C waste management program. This program provides specific requirements for the management and disposal of hazardous wastes, used oils, and universal wastes (ADEQ 2013).

The TDEC manages hazardous materials in accordance with the Tennessee Hazardous Waste Program. The TDEC's administrative rules for hazardous waste management (Chapter 0400-12-01) provide specific requirements for the management and disposal of hazardous waste (TDEC 2012). Projects that include transport, handling, storage, or disposal activities of hazardous chemicals identified during construction or operations and maintenance activities would trigger the need to meet state reporting and waste management requirements under these rules.

The Texas Hazard Communication Act (Texas Health and Safety Code 502.001 et seq.), as amended in 1993, sets the minimum requirements employers must meet for providing information about hazardous chemicals in the workplace to employees and other interested parties and is enforced by the Texas Department of Health. The rules require project developers to compile workplace chemical lists for work sites, train all exposed employees regarding the hazards associated with the chemicals they use, maintain a file of safety data sheets (formerly known as material safety data sheets), and supply the appropriate emergency response personnel with information.

3.8.2 Data Sources

Much of the information presented herein for the health, safety, and intentional destructive acts resource areas relies on the Safety, Security, and Hazards Technical Report for the Project and associated, independently verified references (Clean Line 2013a). The connected actions discussion addressing potential wind energy generation facility development and related substation or transmission upgrades utilizes information and references from the Wind Generation Technical Report for the Project (Clean Line 2014a). The health, safety, and intentional destructive acts analysis herein relies on relevant publicly available information and reports to provide information on the existing affected environment. Sources of information include federal, state, and municipal governments, as well as non-governmental organizations. Security risk- and hazard-related data were obtained through official agency websites or directly from government agencies. In addition, health and safety, security, and hazard information was received from regulatory agencies and other stakeholders during the DOE scoping process.

Noise, traffic, electrical environment, land use, geology, and water resources information was reviewed from other sections of this EIS for applicability to the health and safety resource area. The U.S. Bureau of Labor Statistics' (BLS) website was consulted for worker fatality and injury data. The BLS, like OSHA, is part of the U.S. Department of Labor.

3.8.3 Region of Influence

The ROI for the health, safety, and intentional destructive acts resource area for the Project and connected actions is described in Section 3.1.1 and does not differ for purposes of impact analyses for this resource area.

3.8.4 Affected Environment

This section includes a description of the existing environment for health, safety, and intentional destructive acts such that impacts may be effectively evaluated. The affected environment includes descriptions of worker health and safety, hazardous materials and waste, aircraft and rail operations, fire hazards, natural events and disasters, and intentional destructive acts.

3.8.4.1 Worker Health and Safety

Worker safety in construction and industrial settings is regulated by OSHA. The Project would be subject to OSHA standards during construction and operations and maintenance (e.g., OSHA General Industry Standards [29 CFR Part 1910] and the OSHA Construction Industry Standards [29 CFR Part 1926]). OSHA standards are designed to protect workers from potential construction and industrial accidents, as well as to minimize exposure to workplace hazards (e.g., noise, chemicals).

Industrial health and safety is concerned with occupational and worker hazards during routine operations. The BLS maintains statistics on the incidence of workplace injuries, illnesses, and fatalities. The health and safety incident categories are defined as follows:

- Total recordable cases: The total number of work-related deaths, illnesses, or injuries that result in the loss of consciousness, days away from work, restricted work activity or job transfer, or required medical treatment beyond first aid.
- Days away from work, or days of restricted work activity or job transfer: Cases that involve days away from work, or days of restricted activity or job transfer, or both.
- Worker fatality: Cases that involve the death of a worker.

The incidence rates (cases per 100 full-time workers for non-fatality statistics and cases per 100,000 full-time workers for fatality statistics) maintained by the BLS are calculated separately for different industries based on the reported health and safety cases for that particular industry.

To minimize the effect of industrial health and safety hazards, industries must comply with all applicable regulations that relate to industrial health and safety. Table 3.8-2 summarizes 2012 national safety statistics from the BLS for industry categories that are relevant to the Project.

Table 3.8-2:
2012 National Statistics for Workplace Hazards

Industry	Nonfatal Recordable Incidents (Per 100 FTE Workers)[1]	Lost Workdays (Per 100 FTE Workers)	Fatalities (Per 100,000 FTE Workers)
Construction (all)	3.7	2.0	9.9
Utilities (electric power generation, transmission, control, and distribution)	2.8	1.4	2.5

FTE = Full-time equivalent
1 Nonfatal occupational injury and illness cases requiring days away from work to recuperate.
Source: BLS (2012a, 2012b)

Of the 4,175 worker fatalities that occurred nationally in private industry in calendar year 2012, 806 (19.3 percent) were in construction. The leading causes of worker deaths on construction sites were falls, followed by struck by object, electrocution, and caught-in/between. These "fatal four" were responsible for more than half (54.2 percent) the construction worker deaths in 2012. Eliminating the fatal four would save 437 workers' lives in America every year (OSHA 2013a). Details for these fatal four include the following:

- Falls: 279 out of 806 total deaths in construction in 2012 (34.6 percent)
- Struck by object: 79 (9.8 percent)
- Electrocutions: 66 (8.1 percent)
- Caught-in/between: 13 (1.6 percent)

By comparison, there were 14 fatalities nationally in the private utility industry (electric power transmission, control, and distribution) in calendar year 2012. Causes of worker death in this industry include transportation incidents, exposure to harmful substances or environments, and contact with objects and equipment (OSHA 2013b).

Construction, operations and maintenance, and decommissioning of a transmission line and associated facilities may result in a variety of conditions that present a risk to worker health and safety. A recent article on safety risk management for electrical transmission and distribution line construction found that: “construction contractors account for the highest rate of electrocutions. Within the construction trade, electricians accounted for about 17% of the electrocution fatalities; construction laborers accounted for 9%...and maintenance workers incurred a total of 7%... ” (Albert and Hallowell 2012).

Exposure to certain chemicals can adversely affect human health through toxic reactions, carcinogenic effects, or both. Chemical exposure can occur from chemicals present in water or in soil from past industrial activities. EPA hazardous materials data sources were used to determine known contaminated sites within the ROI. The Applicant conducted site and route selection activities to avoid known contamination sites, so no Superfund sites or brownfield sites are located in the ROI. However, contamination may be encountered where not previously known to occur and is more likely in areas where land uses may have involved the use and/or storage of hazardous materials, including at oil and gas wells, abandoned or active mine sites, oil/gas pipelines, railroads, aerial pesticide application airstrips, and agricultural/commercial/industrial structure sites (Clean Line 2013a).

During construction and operations and maintenance activities, hazardous materials including vehicle fuels, oils, and other vehicle maintenance fluids would be stored and used in construction staging areas and necessary operational work areas. During these activities, mismanagement or accidental releases of these materials could contaminate soil and/or water resources and have adverse effects on human health and the environment. Examples of hazardous wastes include spent hazardous materials and by-products from their use.

A number of hazardous substances are used in the construction, operation, and maintenance of electrical transmission lines and associated facilities. Table 3.8-3 lists common types of materials that could be used, but is not a comprehensive list. Generation of hazardous waste is not anticipated; however, the Applicant would implement applicable EPMs and follow regulatory processes if construction and industrial processes resulted in the generation of hazardous waste.

Table 3.8-3:
Hazardous Materials Typically Used for Transmission Line Construction

Hazardous Material			
2-cycle oil (contains distillates and hydro-treated heavy paraffinic)	ABC fire extinguisher	Acetylene gas	Air tool oil Insulating oil (inhibited, non-polychlorinated biphenyl)
Ammonium hydroxide	Antifreeze (ethylene glycol)	Automatic transmission fluid	Battery acid (in vehicles and in the meter house of the substations)
Bottled oxygen	Brake fluid	Canned spray paint	Chain lubricant (contains methylene chloride)
Connector grease (penotox)	Contact Cleaner 2000 (1,1,1-trichloroethene)	Diesel deicer	Diesel fuel
Diesel fuel additive	Gasoline	Gasoline treatment	Hot stick cleaner (cloth treated with polydimethylsiloxane)
Hydraulic fluid	Lubricating grease	Mastic coating	Methyl alcohol
Motor oils	Paint thinner	Pesticide	Propane
Puncture seal tire inflator	Safety fuses, implosive connectors, conductor splices, deadend assemblies	Starter fluid	Sulfur hexafluoride (within the circuit breakers in the substations)
Potassium hydroxide—nickel-cadmium batteries	WD-40 (penetrating oil)	Edisol XT—insulating oil used in capacitor banks	Transformer oil—insulates and cools transformers

Source: Clean Line (2014b)

3.8.4.2 Aircraft and Rail Operations

Fifty-two known aircraft facilities (airports, airstrips, and heliports) are located within the ROI for transportation impact analyses, which includes a 6-mile-buffer around Project components (see Section 3.16.3). It is possible, however, that unknown private or unofficial airstrips may be located within the ROI or nearby. In addition, the Project is located within agricultural areas where aerial application of herbicides, pesticides, and fertilizers is a common practice for certain crops (commonly known as crop dusting). Section 3.16.4.4 and Section 3.16.5 (by region) present detailed airport and aircraft operation information applicable to health and safety impact analyses discussed later.

Numerous rail lines are located within the transportation resource area ROI (6-mile area around Project components) as shown on Figures 3.16-1a through 3.16-1f in Appendix A. Railroads are more specifically discussed in Section 3.16.5 by region. Railroads were identified based on the potential encroachment within the ROI, which refers to areas where railroads and railroad ROWs might be affected because the Project would cross the railroad ROW or be located in close proximity to the railroad.

3.8.4.3 Fire Hazards

A wildfire is an uncontrolled fire spreading through vegetative fuels and could occur at any point within the ROI. Oklahoma has a significant wildfire hazard given its climate and the types of vegetative fuels present. Fire season in Oklahoma has been identified as lasting from July through April (ODEM 2011). Wildfires have occurred in every county in Arkansas, but they are most common in the south-central and southwestern parts of the state within the heavily forested Gulf Coastal Plain and southern Ouachita Province (ADEM 2013). The Project would be located in the northern portion of Arkansas, which is primarily categorized as having a low to medium occurrence of wildfire events over the period 1997 to 2012 (ADEM 2013).

3.8.4.4 Natural Events and Disasters

Natural events and disasters consisting of extreme weather, ground surface and subsurface instabilities (e.g., earthquakes), and flooding have the potential to cause damage to Project facilities with resultant impacts to worker and public health and safety.

Severe weather such as thunderstorms, lightning, high winds, ice storms, and tornadoes may occur during all phases of the Project since activities would be conducted year-round. Tornadoes and thunderstorms are most likely to occur during spring, summer, and fall; ice storms could occur during late fall, winter, and early spring; and high winds may occur at any time of year. Weather forecasts are generally accurate at predicting potential periods when severe weather may occur and forecasts would be monitored during construction. Tornadoes are a particular concern in the ROI and have occurred in each Oklahoma County approximately two to three times per year on average based on data from 1950 to 2013; the majority of the tornadoes recorded were in lower strength categories measuring less than F-3 on the Fujita scale[1] (THP 2014). In Arkansas and western Tennessee, tornadoes occur in the vicinity of the ROI approximately once or twice per year on average during the same reporting period identified above, and the majority also were in lower strength categories (THP 2014).

Surface and subsurface ground instabilities such as earthquakes, faulting, liquefaction, landslides, and subsidence could have an effect on the health and safety of workers and the public. Section 3.6 describes the affected environment and impact analyses for geology, paleontology, minerals, and soils including locations of active faults and seismic risk scenarios for the various components, facilities, and routing locations of the Project.

Flooding is another natural event that could have an effect on Project components with resultant impacts to the health and safety primarily of workers. Section 3.15 describes the affected environment and impact analyses for surface water resources including watersheds, surface water features, water quality, and water use. Section 3.19 describes the affected environment and impact analyses for wetlands, floodplains, and riparian areas including definitions and locations of floodplains applicable to the Project.

3.8.4.5 Intentional Destructive Acts

There are not any specific sources of information regarding acts of terrorism specific to the ROI; however, three incidents of intentional destructive acts, alleged to be sabotage, occurred in September and October 2013 to a high-voltage transmission line in Arkansas and are under investigation by the Federal Bureau of Investigation (Blinder 2013).

Equipment theft is also a growing concern that is very costly to construction projects. According to the National Insurance Crime Bureau, between $300 million to $1 billion a year is lost nationwide to the theft of construction equipment (NICB 2012). A 2008 industry research study commissioned by LoJack Corporation and the National Insurance Crime Bureau showed that 71 percent of equipment owners have experienced the theft of equipment in the previous year (LoJack 2012). According to LoJack, the types of equipment most frequently stolen are light utility work trucks and trailers, loaders, skid steers, and generators/air compressors/welders.

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[1] The Fujita scale, more popularly known as the F scale is used to measure the intensity of a tornado based on the amount of damage done by a passing tornado over an area. The F scale rates a tornado from F-0 to F-5 with a F-5 tornado having the fastest wind speeds and causing the most damage

Energy transmission has become increasingly reliant on computer-based control systems that operate and monitor energy infrastructure. The following points were extracted from a DOE-sponsored report through the Energy Sector Control Systems Working Group (ESCSWG 2012) addressing cyber security threats to energy delivery systems:

- "Because the private sector owns and operates most of the energy sector's critical assets and infrastructure, and governments are responsible for national security, securing energy delivery systems against cyber threats is a shared responsibility of both the public and private sectors."
- "Smart technologies (e.g., smart meters, phasor measurement units), new infrastructure components, the increased use of mobile devices, and new applications are changing the way that energy information is communicated and controlled while introducing new vulnerabilities and creating new needs for the protection of consumer and energy market information."
- "Adversaries have pursued progressively innovative techniques to exploit flaws in system components, telecommunication methods, and common operating systems found in modern energy delivery systems with the intent to infiltrate and sabotage them."

3.8.4.6 Protection of Children

Electrical and magnetic fields are known to occur around transmission lines, distribution lines and electric appliances. Extensive scientific research has been conducted in the United States and around the world to determine whether exposure to power-frequency AC electric and magnetic fields has any potential to produce human health effects among adults and children. Section 3.4.11.2.1.2.2.7 presents an overview of the scientific literature on potential health effects of AC electric and magnetic fields, including epidemiology studies on potential health effects on children. Sections 3.4.11.2.2.2.1 and 3.4.11.2.2.2.2 present AC electric and magnetic field calculations for the various structure and transmission line configurations for the Project.

3.8.4.7 Connected Actions

3.8.4.7.1 Wind Energy Generation

Worker activities occurring during construction and operation of wind energy generation facilities typically involve major actions such as establishing site access, excavating and installing structure foundations, working at heights (e.g., erecting turbines, nacelle and blade placement, and turbine maintenance), constructing support buildings and electrical substations, assembling and erecting meteorological towers, constructing access roads, and routine maintenance of ancillary facilities and components. Decommissioning presents many of the same hazards to the workforce as construction. Construction and operations workers at any facility are subject to risks of injuries and fatalities from physical hazards. While such occupational hazards can be minimized when workers adhere to safety standards and use appropriate protective equipment, fatalities and injuries from accidents can still occur with rates consistent with the data presented in Table 3.8-2. Many of the occupational hazards associated with wind energy generation projects are similar to those of the heavy construction and electric power industries.

A potential physical effect of operating wind turbines is shadow flicker and blade glint and glare. These terms refer to the phenomenon that occurs when the moving blades of wind turbines cast moving shadows (shadow flicker) or reflections (blade glint or glare) that cause a flickering effect. When the sun is in such a position in relation to the blades, and the shadow or reflection falls across occupied buildings, the light passing through windows can disturb the occupants. This can be viewed by observers as either brief changes in brightness in an indoor environment or by moving shadows on the ground in an outdoor environment. The type of turbine, landscape features, latitude, weather, and wind energy generation facility layout are all factors that would impact shadow flicker and blade glint and glare (Bos et al. 2013).

Construction, routine operations and maintenance, and decommissioning of wind turbines would include the use of some hazardous materials such as fuels, greases, lubricants, coolants, paints, and/or coatings for corrosion control. Hazardous materials, such as insulating fluids in electrical transformers, may also be present at substations. Information and data regarding potential existing soil contamination within WDZs are based on available information from regulatory databases including EPA's Facility Registry Services database, which lists facilities that are required to report hazardous waste management activities but does not necessarily identify sites where soil contamination has occurred. Table 3.6.2-18 lists Facility Registry Services sites within WDZs; one site in WDZ-A and one in WDZ-D are indicated as having soil contamination and are in some stage of clean up (see Section 3.6.2.5.1). It is possible; however, that other unknown hazardous waste sites may be encountered during potential wind energy generation facility development especially during foundation and cable trench excavations.

Wind turbines, generation tie lines, substations, and associated facilities could be targets of intentional destructive acts, such as sabotage, terrorism, vandalism, and theft. Such acts include cyber-attack; gunfire at turbines, generation tie lines, transmission structures, or substation and support building equipment; vandalism; and theft of equipment, supplies, tools, or materials. Theft is the most likely threat during wind energy generation facility construction, operations and maintenance, and decommissioning. There are no sources of information regarding acts of terrorism specific to specific wind energy generation facility development areas. However, there is anecdotal evidence that this should be a concern to wind energy generation facility developers. An investigation into a recent turbine collapse in the United Kingdom revealed that bolts were missing from the base (Collins 2013). Though the turbine collapsed during a high wind event, it is being speculated that it could be the result of an intentional act (Collins 2013).

3.8.4.7.2 Optima Substation

The future Optima Substation would be constructed on approximately 160 acres partially within the area identified on Figure 2.1-3 in Appendix A as the AC Interconnection Siting Area. The descriptions of the affected environment in Sections 3.8.4.1 through 3.8.4.6 are applicable to the future Optima Substation. The same worker health and safety accident statistics for the construction and operational electric utility industry would apply to the construction and operations and maintenance of the future Optima Substation.

3.8.4.7.3 TVA Upgrades

As described above under Section 3.1.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.8.4.8 Regional Description

The description of the affected environment provided in Section 3.8.4 is applicable to all seven regions across Oklahoma, Arkansas, Texas, and Tennessee and to areas associated with connected actions in these states.

3.8.5 Impacts to Health and Safety

Electric transmission projects may affect worker and public health and safety during construction, operations and maintenance, and decommissioning. Additionally, project components could become the target of intentional destructive acts or sabotage (e.g., terrorist attack or mischievous actions). Potential health and safety concerns related to power transmission during construction include worker injuries; exposure to hazardous materials, contaminated sites, or excessive noise; and other risks to workers and the surrounding community from technological and natural hazards that could result in accidents within the ROI (Section 3.8.3). Health and safety concerns associated with operations and maintenance include electrical shock, electric and magnetic fields, corona, stray and induced voltage, collision hazards, fire risk, and public access to transmission structures and substation equipment.

Specific Project-related activities that could cause impacts include:

- Operating equipment near energized lines
- Energized lines/equipment put in service
- Excavation/trenching and installing foundations
- Climbing poles/operating aerial lifts
- Grounding/removing grounding
- Framing of temporary and permanent structures
- Inspecting/troubleshooting power lines/equipment
- Splicing, repairing, and installing conductors and wiring
- Clearing/trimming trees and bushes
- Moving energized conductors
- Assembling/repairing equipment and hardware
- Traffic control
- Hanging and installing transformers and vaults
- Installing and connecting busses, switches, circuit breakers, and regulators
- Installing conduit or cable trough
- Installing insulators
- Assembling and erecting substations
- Removing/replacing existing line
- Installing lightning arrestors
- Sagging to provide clearance between wires
- Attaching/replacing insulators
- Replacing shield wire
- Installing/removing dampers
- Installing/removing spacers
- Metering, testing, and measuring

3.8.5.1 Methodology

The methodology for evaluating impacts on health and safety and from intentional destructive acts involves identifying and assessing Project design, construction, operational and maintenance standards, and decommissioning guidelines for electric transmission lines and associated components. The Applicant has conducted research and evaluations addressing potential health and safety impacts associated with the Project (Clean Line

2013a). DOE has reviewed and verified these evaluations for applicability and where appropriate, has summarized them and other applicable information in the impact analyses in the following sections.

The Applicant has developed, and would implement, the EPMs listed in Appendix F to avoid or minimize potential impacts from construction and operations and maintenance of the Project. Activities described in Appendix F would incorporate and be subject to the EPMs as well as measures/requirements imposed as part of federal or state permits and authorizations. The measures that would specifically minimize the potential for impacts on health and safety are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-3: Clean Line will minimize clearing vegetation within the ROW, consistent with a Transmission Vegetation Management Plan filed with NERC, and applicable federal, state, and local regulations.
- GE-5: Any herbicides used during construction and operations and maintenance will be applied according to label instructions and any federal, state, and local regulations.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-12: Clean Line will avoid remedial structures (e.g., capped areas, monitoring equipment, or treatment wells) on contaminated sites, Superfund sites, CERCLA remediation areas, and other similar areas. Workers will use appropriate protective equipment and appropriate safe working techniques when working at or near contaminated sites.
- GE-13: Emergency and spill response equipment will be kept on hand during construction.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-16: Where required by FAA, or in certain areas to protect aviator safety, Clean Line will mark structures and/or conductors and/or shield wires with high-visibility markers (i.e., marker balls or other FAA-approved devices).
- GE-19: Clean Line will properly ground permanent structures (e.g., fences, gates) to reduce the potential for induced voltage and currents onto conductive objects in the ROW.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- GE-25: Clean Line will turn off idling equipment when not in use.
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system and surveying of existing facilities.
- AG-5: Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., crop dusting) of herbicides, fungicides, pesticides, and fertilizers within or near the

transmission ROW. Clean Line will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure.

Clean Line will also develop the following plans or procedures to implement the EPMs:

- Blasting Plan. This plan will describe measures designed to minimize adverse effects due to blasting.
- Spill Prevention, Control and Countermeasures (SPCC) Plan. This plan will describe the measures designed to prevent, control, and clean up spills of hazardous materials.
- Transmission Vegetation Management Plan (TVMP). This plan, to be filed with the North American Electric Reliability Corporation (NERC), will describe how Clean Line will conduct work on its right-of-way to prevent outages due to vegetation.
- Construction Security Plan. This plan will describe measures designed to avoid and/or minimize adverse effects associated with breaches in Project security during construction including terrorism, sabotage, vandalism, and theft. The plan will include provisions describing how the Project construction team will coordinate with state and local law enforcement agencies during construction to improve Project security and facilitate security incident response, if required.
- Transportation and Traffic Management Plan. This plan would include railroad crossing protocols and construction and post-construction practices to avoid vehicle, railroad, and transmission line conflicts. Typically, stoppage of railroad traffic is not required during construction or conductor stringing and tensioning activities. Crossing activities are similar to those for road crossings and typically involve the use of guard structures. Stringing and tensioning activities would be performed in coordination with the appropriate railroad authorities as required.

3.8.5.2 Impacts Associated with the Project

The impacts discussed below are common to all components of the Project within Oklahoma, Arkansas, Tennessee, and Texas, including converter stations and AC interconnections, the HVDC transmission line, AC collection system transmission lines, access roads, multi-use construction yards and other temporary construction areas, and communications sites. There are no appreciable differences in health and safety impacts between the Applicant Proposed Project and DOE Alternatives unless otherwise stated in specific sections below because Project components, construction and operation processes, and facility footprints would be the same or similar.

3.8.5.2.1 Construction Impacts

Construction activities could pose hazards that affect worker and public health and safety. In addition, natural disasters, accidents, or intentional destructive acts or mischief could impact the health and safety of construction workers and the public. The following sections include a qualitative summary of each hazard and its relative frequency, severity, potential impacts, and avoidance and minimization measures for the construction phase.

3.8.5.2.1.1 Worker and Public Health and Safety

Accidents during construction that could present a worker and public health and safety risk include heavy equipment and commuting vehicle accidents, electrocution, personal accidents (e.g., slips, trips, and falls), hazardous materials spills, construction-induced fires, and aircraft accidents.

Construction activities pose various health and safety risks to workers that are considered typical for large construction projects involving electrical components, working at height, and operating heavy machinery. The following potential risks could be associated with the Project:

- Falls from working at height
- Crush injuries in excavation work
- Slips and trips
- Cuts and scrapes from sharp tools or construction materials or debris
- Receiving injuries from hand tools and/or rotating machinery
- Electrocution
- Being struck by falling objects
- Manually lifting heavy loads
- Bad working positions, possibly in confined spaces
- Being struck or crushed by a workplace vehicle
- Inhalation of dust
- Handling of rough materials
- Exposure to dangerous substances (chemical and biological)
- Working near, in, or over water
- Hearing damage from loud noises
- Sustaining injuries as a result of an on-road or off-road accident involving a motor vehicle or construction equipment

Based on BLS data reported nationally within the construction industry (BLS 2012a), there were 3.7 non-fatal recordable incidents per 100 full-time equivalent workers. A full-time equivalent worker equates to 2,080 labor hours annually. Using the BLS data, based on an average full-time equivalent construction workforce of approximately 965 workers (Clean Line 2013b; Thomas 2014) working for 42 months on all components of the Applicant Proposed Project, it is estimated there would be approximately 125 non-fatal recordable incidents associated with the construction phase. Also, BLS data reported nationally within the construction industry identify 9.9 fatal incidents per 100,000 full-time equivalent workers (BLS 2012b). Using the average construction workforce of 965 workers, it is estimated that there would be approximately 0.3 fatalities during the 42-month construction phase.

3.8.5.2.1.2 Aircraft and Rail Operations

Airports and associated air traffic in the vicinity of the components of the Project have the potential to result in impacts to workers, aircraft occupants, and Project components if an aircraft collides with a structure. The use of helicopters during Project surveying, structure installation, and line and conductor stringing could result in accidents that cause health and safety impacts to workers. Low-altitude aircraft that apply pesticides, herbicides, and fertilizers on nearby agricultural operations could result in an increased risk of collision with Project components, especially lines and conductors, which aircraft operators have more difficulty seeing. An aircraft collision is possible and would be expected to result in major injury or death—more likely to the aircraft occupants but possibly people on the ground. Additionally, an aircraft collision with Project facilities or components could cause significant damage to Project assets during construction. Environmental Protection Measure GE-16 would ensure Project structures and components are appropriately marked with devices to help aviators identify potential dangers to aircraft operations.

As identified in Section 3.16, railroads cross at several points or are in close proximity to the Applicant Proposed Route and the various DOE alternative routes. No increase in railroad traffic is expected to occur as a result of the construction of the Project, and therefore no additional health and safety risk would result. Structure heights and placement, span lengths, and vertical clearance would be determined in accordance with the NESC, the Applicant's design criteria, and applicable standards and laws. The NESC provides for minimum distances between the conductors and the ground, crossing points of other lines and the transmission support structure, and other conductors, and minimum working clearances for vehicles and personnel.

3.8.5.2.1.3 Fire Hazards

Wildfires in the vicinity of the ROI as a result of lightning strikes or accidental events can cause risks to Project components and personnel during construction. Although not necessarily caused by construction activities of the Project, once ignited, a wildfire could spread causing injuries to workers or the public and damage to Project facilities, construction equipment, and construction materials. A wildfire during the construction phase of the Project is considered possible, but it would not be expected to result in permanent or significant damage to Project components or health and safety of workers or members of the public since emergency reporting and response actions coupled with identified EPMs would minimize impacts.

The potential for construction activities to start a fire represents a potential safety hazard for workers or nearby residents. Fire hazards could result from workers welding, operating motorized construction equipment, smoking, refueling, electrical mishaps while energizing components, and operating or parking vehicles in areas with dry vegetation. With implementation of adequate preparedness and response measures, the potential for a fire to cause major damage to Project components or to result in injuries or death to workers or members of the public is considered unlikely.

3.8.5.2.1.4 Natural Events and Disasters

Project facilities and components may be susceptible to natural events and disasters and could be damaged by extreme weather, ground surface and subsurface instabilities (e.g., earthquakes), and flooding. Failure of partially constructed transmission line components from natural events can result in structures and lines falling to the ground; impacts would generally be limited to the Project ROW. Damage to Project infrastructure may result in temporary adverse impacts to worker and public health and safety and nearby property. Natural events and disasters may occur on a relatively frequent basis; however, severe events would be less likely to result in structural damage or downed lines and conductors since the Project would be designed and built according to federal, state, and industry building codes and standards, which are intended to avoid or minimize safety risks posed by natural events and disasters.

Sudden severe weather during construction could result in hazardous conditions for workers including difficulty in controlling equipment and structural components, difficulty working at heights, reduced visibility, poor road conditions, impaired footing, and increased possibility of electrocution.

Surface and subsurface instabilities and displacement from earthquakes, faulting, liquefaction, landslides, and subsidence is a possibility during construction activities. Collapse of structures or falling objects pose potential risks to workers or nearby members of the public. Ground instability or failure associated with events described above occurs with little or no notice and preparation by onsite personnel would be minimal. Based on USGS earthquake-risk scenarios, seismic hazards are low for the entire Project area except for the eastern portion of the ROI in Region 5 and all of Regions 6 and 7 as the Project routes approach a relatively active seismic zone (see Sections 3.6.1.5.3

through 3.6.1.5.7). While the area's seismic hazard increases south of the ROI in Regions 2 and 3, the hazard for the ROI in these regions is low. Some areas within the regions have a range of susceptibility and incidence rates for ground instability events (see Table 3.6.1-11 through 3.6.1-19). Compliance with federal and state earthquake preparedness and response procedures would help ensure risks to workers and the public during seismic events would be minimized.

The occurrence of flooding during construction could put workers at risk of drowning. Flooding may also cause erosion that may damage construction sites and access routes or create spills of hazardous materials with resulting human exposure to environmental contamination or injury. However, flood events can often be forecast, which allows time to prepare, so the most severe impacts of flooding can more likely be avoided. Although construction and placement of structures in 100-year floodplains would be avoided as much as possible, all seven regions contain several 100-year floodplains that would potentially be crossed by the Applicant Proposed Route or the DOE alternative routes (see applicable discussions in Section 3.19). Placement of some structures within 100-year floodplains would be unavoidable in some areas (e.g., approaches to the Mississippi River).

3.8.5.2.1.5 Intentional Destructive Acts

Although it is not possible to predict whether acts of terrorism or sabotage events would occur, or the nature of such events if they did occur, DOE has considered the potential for events involving terrorism, sabotage, or criminal mischief that could result in health and safety impacts to workers and members of the public. Also, sabotage of onsite equipment or placement of explosive devices that could disrupt the Project is a remote possibility. Impacts to health and safety from intentional destructive acts would be unlikely to be greater than events involving extreme weather. A more likely scenario would involve mischievous or criminal acts of theft or vandalism, which would generally pose lower safety risks. Theft of tools, equipment, and construction materials is a relatively common occurrence at large sites, especially when spread across large geographic areas where security is more difficult to maintain. Impacts could result in schedule and cost delays to the construction effort. Although the possibility of some theft or vandalism is considered likely, related health and safety impacts to workers or the public are negligible.

As identified earlier, the Applicant would prepare a comprehensive Construction Security Plan that would describe measures designed to avoid and/or minimize adverse effects associated with breaches in Project security during construction, including terrorism, sabotage, vandalism, and theft. This plan would include provisions describing how the Project construction team and operations and maintenance personnel would coordinate with state and local law enforcement agencies to improve Project security and facilitate security incident response if required.

3.8.5.2.1.6 Protection of Children

While the potential for effects on members of the public from construction activities cannot be dismissed, the Project is not expected to cause any disproportionate effects on people less than 18 years of age. (Children are factored into construction impact analyses as members of the general public.)

3.8.5.2.2 Operations and Maintenance Impacts

Operations and maintenance activities could pose hazards that affect worker and public health and safety. In addition, natural disasters, accidents, or intentional destructive acts or mischief could impact the health and safety of operational workers and the public. The following sections include a qualitative summary of each hazard and its relative frequency, severity, potential impacts, and avoidance and minimization measures for the operations and maintenance phase.

3.8.5.2.2.1 Worker and Public Health and Safety

During the operations and maintenance phase of the Project, potential health and safety impacts to workers would be similar to those described during the construction phase. Electrocution remains a safety concern during operations and maintenance activities that occur in close proximity to or under transmission lines or at converter stations. The Project components would be designed and built to NESC guidelines, minimizing the risk of electrocution (IEEE 2011). Potential injuries or fatalities to workers could also occur from falls from heights, equipment and vehicle accidents, and other operational and maintenance activities. Because day-to-day activities with regard to operating equipment and vehicles and hazardous materials management would be less during operational activities than during construction, the frequency of accidents that could affect members of the public would also be less. Electrical and magnetic field impacts and potential health effects are discussed in Section 3.4.6.

Based on BLS data reported nationally within the electric utility industry (BLS 2012a), there were 2.8 non-fatal recordable incidents per 100 full-time equivalent workers annually. Using the BLS data, based on an average full-time equivalent operations workforce of approximately 72 individuals (See Section 2.1.5) working over the assumed 80-year operational phase of the Applicant Proposed Project, it is estimated there would be approximately 2.0 non-fatal recordable incidents annually. Also, BLS data reported nationally within the utility industry identify 2.5 fatal incidents per 100,000 full-time equivalent workers (BLS 2012b). Using the average operations workforce of 72 workers, it is estimated that there would be approximately 0.002 fatalities annually during the operational phase.

3.8.5.2.2.2 Aircraft and Rail Operations

A fully constructed and operating transmission system could pose long-term hazards to low-flying aircraft in the vicinity of the Project. Structure heights are not expected to exceed 180 feet along the majority of the Project, but could reach heights of approximately 380 feet at the Mississippi River crossing to maintain necessary clearance over the navigable channels. Potential health and safety impacts to workers, members of the public, and aircraft operators and passengers could occur from low-flying aircraft that use nearby airports and landing strips or that conduct aerial application of herbicides, pesticides, and/or fertilizers on nearby croplands. Low-flying aircraft would present a potential hazard to worker and public health and safety, Project assets, and the power supply for the life of the Project up until the facilities are decommissioned and removed. EPM GE-16 would ensure Project structures and components are appropriately marked with devices to help aviators identify potential dangers to aircraft operations.

As explained in Section 3.8.5.2.1.2, no increase in railroad operations is expected to occur as a result of any phase of the Project, so no increased health and safety risk would result.

3.8.5.2.2.3 Fire Hazards

Potential fire hazards would remain during the operations and maintenance phase of the Project. Events that may cause fires include ignition from airborne debris that comes in contact with electrical system components, natural debris buildup on insulators, vegetation contact with transmission lines, and incidents involving firearms. Wildlife interactions with Project components (e.g., perching birds) are not expected to cause bridging between two electrical conductors given the large separation between components which, depending on the type of structure used, would provide a minimum conductor separation distance of approximately 21 feet (see Figures 3.4-21 and 3.4-22 for typical

345kV configuration, Figures 3.4-29 and 3.4-30 for typical ±600kV configuration). Higher-voltage transmission lines (like the Project), where conductors are separated by relatively large distances, makes electrical arcing between components and resultant ignition of fires much less likely.

3.8.5.2.2.4 Natural Events and Disasters

Given the relatively long timeframe of the operations and maintenance phase (assumed to be 80 years), natural events and disasters consisting of severe weather (e.g., ice and windstorms and tornadoes) and ground instability events (e.g., earthquakes) are possible. Project components could fail in a manner that would result in collapse of structures with resultant health and safety concerns and disruption of electrical service. Impacts would typically remain within the ROW but may extend beyond in extreme cases (e.g., a tornado with sufficient strength to transport dislodged structural material from the Project beyond the ROW). As with the construction phase, natural events and disasters may occur relatively frequently, but an event severe enough to result in structural damage or downed lines with resultant health and safety hazards or significant disruption of electrical service is less likely since the Project would be designed, built, and operated according to federal, state, and industry building codes and standards, which are intended to avoid or minimize safety risks posed by natural events and disasters.

3.8.5.2.2.5 Intentional Destructive Acts

Although it is not possible to predict if acts of terrorism or sabotage events would occur, or the nature of such events if they did occur, DOE has considered the potential for events involving terrorism, sabotage, or criminal mischief that could result in health and safety impacts to workers and members of the public. Impacts would be similar to those described for construction. The impacts of terrorism or sabotage of structures or other equipment could range from no noticeable effect to loss of electrical service to some service areas for a period of time. A terrorist cyber-attack could potentially impact operating and communications systems leading to a disruption in service. Although such an attack is possible, the consequences would not be considered major regarding health and safety concerns, although they would be considered critical due to potential impact to the local energy system and grid.

Theft, vandalism, or other mischievous acts could cause safety risks to perpetrators as well as workers and members of the public. Destructive acts such as firearm use near the Project components, including shooting at Project equipment, components, and structures, may cause fires, electrical hazards, personal injury, or death to people in the area. Theft of equipment, supplies, tools, or materials is also a possibility, although less likely than during construction when more equipment would be accessible.

3.8.5.2.2.6 Protection of Children

Electric and magnetic fields are known to occur around transmission lines, distribution lines, and electric appliances. As discussed in detail in Section 3.4.11.2.1.2.2.7, research has been conducted in the United States and around the world to determine whether exposure to power-frequency AC electric and magnetic fields has human health effects.

The general consensus among researchers and the medical and scientific communities is that there is insufficient evidence at this time to conclude whether magnetic fields are a cause of adverse health issues. A review of available literature on the health risk posed by AC electric and magnetic fields was conducted by the World Health Organization (WHO) Task Group (other studies and reviews are discussed in detail in the section cited above). The WHO report, *Environmental Health Criteria 238* (WHO 2007), concluded that:

> Scientific evidence suggesting that every day, chronic low-intensity (above 3–4 mG) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level power-frequency magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.

In addition, The National Institute of Environmental Health Sciences (NIEHS) report to the United States Congress, at the conclusion of its multi-year Electric and Magnetic Fields (EMF) Rapid Program, summarized its research and concluded that "The scientific evidence suggesting that extremely low frequency EMF exposures pose any health risk is weak" (NIEHS and NIH 2002).

3.8.5.2.3 Decommissioning Impacts

Potential impacts related to worker and public health and safety and hazards during the decommissioning phase of the Project are expected to be similar to those that could occur during the construction phase. As indicated in Section 2.1.6, a comprehensive decommissioning plan would be prepared prior to decommissioning the Project. This plan would include procedures to minimize safety risks to workers and the public.

3.8.5.3 Impacts Associated with the DOE Alternatives

Potential impacts associated with the Project with the DOE Alternatives within Oklahoma, Arkansas, and Tennessee, including the Arkansas converter station and AC interconnection, the HVDC transmission line alternative routes, access roads, multi-use construction yards and other temporary construction areas, and communications sites, would be similar to those discussed above for the Applicant Proposed Project (Section 3.8.5.2) except for potential injury and fatality statistics, which are discussed below.

The construction impacts to worker health and safety from the Project with the DOE Alternatives would depend on the number of workers, which is related to the length of the routes, ruggedness of terrain, and other factors. The ruggedness of the terrain would also increase the potential health and safety risk associated with construction of the HVDC transmission line. Approximately half of the alternative routes are equal to or shorter than the Applicant Proposed Route; the other half are somewhat longer. The total length of the alternative routes is roughly equivalent to that of the corresponding links of the Applicant Proposed Route. Therefore, the number of workers required for construction of the alternative routes would not be substantially different than the estimate calculated for the Applicant Proposed Project discussed above. This would result in no appreciable change in health and safety impacts to workers from construction of the HVDC transmission line.

The addition of the Arkansas converter station would increase the required construction workforce by approximately 10 percent based on the contribution of a typical converter station to the total workforce required for the Applicant Proposed Project (see Appendix F). Because the addition of the Arkansas converter station would not replace any elements of the Applicant Proposed Project, the estimated health and safety impacts associated with construction of the Arkansas converter station would increase the number of workers and thus the number of non-fatal recordable incidents and potential fatalities by roughly 10 percent over that estimated for the Applicant Proposed Project.

The addition of the Arkansas converter station would increase the number of operational workers by 15 over that of the Applicant Proposed Project of 72 operational workers. Based on BLS data reported nationally within the electric utility industry (BLS 2012a), there were 2.8 non-fatal recordable incidents per 100 full-time equivalent workers. Using the BLS data, based on an average full-time equivalent operations workforce of approximately 87 individuals (Clean Line 2013b; Thomas 2014) working over the assumed 80-year operational phase of the Project, it is estimated there would be approximately 2.4 non-fatal recordable incidents annually. Also, BLS data reported nationally within the utility industry identify 2.5 fatal incidents per 100,000 full-time equivalent workers (BLS 2012b). Using the average operations workforce of 87 workers, it is estimated that there would be approximately 0.002 fatalities annually during the operational phase.

3.8.5.4 Best Management Practices

Each of the phases of the Project would be planned, coordinated, and conducted in a manner that protects worker and public health and safety and mitigates or minimizes impacts as described above. Specific EPMs and Project plans and procedures (see Section 3.8.5.1) would be implemented to help ensure protection of workers and the public from identified hazards and intentional destructive acts. Additional practices identified by DOE would minimize the safety risks and consequences posed during construction and operations and maintenance of the Project. However, despite preparedness planning, worker training, and application of safety procedures, accidents may still occur. Although there may be some overlap or inclusion within Applicant-identified EPMs and Project plans, the following BMPs identify additional measures to further ensure impacts are minimized:

- Develop and implement a Health and Safety Plan that describes regulatory requirements, procedures, and practices for conducting activities to help ensure a safe working environment, which for purposes of health and safety measures should include:
  - Fire prevention, suppression, and emergency responder contact procedures
  - Natural disaster and severe weather reporting and contact procedures
  - Law enforcement contact procedures
  - Procedures for addressing hazardous materials spills and other mishaps
  - Helicopter flight safety measures
- Develop and implement a Communications Plan. Section 3.1.2 describes the elements of this plan, which for purposes of health and safety should include:
  - Liaison and public outreach activities with local airports, aviation communities, aviation regulatory bodies, aerial agricultural spraying operations, and railroad operators.
  - Local media and public outreach procedures for applicable hazard communication notices

3.8.5.5 Unavoidable Adverse Impacts

Based on national nonfatal and fatal workplace injury statistics tracked by the BLS (see Table 3.8-2), accidents resulting in worker injuries and possibly death could occur during the construction and/or operations and maintenance phases of the Project. The hazardous nature of the work, the complexity of the electrical system, and the size and areal extent of the Project all would contribute to a potential for worker injuries or death and would be considered unavoidable adverse impacts. These unavoidable adverse impacts could be as a result of common personnel-involved injuries (e.g., slips, trips, or falls), hazardous materials or waste accidents, aircraft incidents, fire hazards, natural events or disasters, or intentional destructive acts.

3.8.5.6 Irreversible and Irretrievable Commitment of Resources

The health of workers and the public are important resources that must be protected. Through the implementation of safety plans, procedures, and required design elements, irreversible commitment of these resources would be kept to a minimum.

3.8.5.7 Relationship between Local Short-term Uses and Long-term Productivity

While there would be a short-term temporary increase in potential health and safety impacts associated with construction, long-term impacts in the region would not increase and would not affect the productivity of the region.

3.8.5.8 Impacts from Connected Actions

3.8.5.8.1 Wind Energy Generation

During construction and operations and maintenance of wind energy generation facilities, potential health and safety impacts to workers and the public would be similar to those described for the Project. Wind energy generation facility developers would be expected to adopt and implement common industry practices and to comply with applicable regulations to protect worker and public health and safety. Installation and operation of wind turbines and associated components present many of the same types of health and safety impacts from working at heights and in an electrically charged environment that are associated with transmission system installations with some exceptions, which are discussed below.

Depending on the alternative selected, the electrical power delivery capacity of the Project would range between 3,500 and 4,000MW. To achieve full utilization of the 3,500 to 4,000MW delivery capacity of the Project, actual wind capacity build-out would be expected to range between 4,200 to 4,550MW, which takes into account line losses, equipment outages, variation in wind turbine power generation, and other operational conditions (Clean Line 2014a, 2014c). Construction of typical, commercial-scale wind energy generation facilities in the Oklahoma or Texas panhandle regions[2] would employ approximately 57 to 515 full-time equivalent workers (Clean Line 2014a) over a 2-year construction period. The minimum full-time equivalent workforce is based on a small-scale wind generation facility with a combined turbine nameplate rating of approximately 53MW (fifteen 3.5MW turbines) and the maximum value is based on a large-scale wind energy generation facility with a combined turbine nameplate rating of 975MW (six hundred fifty1.5MW turbines). Operation of typical commercial-scale wind energy generation facilities in the Oklahoma or Texas panhandle regions would employ approximately 4 to 44 workers annually (Clean Line 2014a).

For purposes of analyses, the following construction and operational calculations are based on the maximum wind capacity build-out of 4,550MW to supply the Project, which could consist of 12 small-scale and 4 large-scale wind

[2] Although wind generation facility development could occur in Oklahoma or Texas, Oklahoma employment estimates from Clean Line 2014a are used in this EIS for Texas. (The employment estimate for Texas identified in Clean Line 2014a is 56 to 494 full-time equivalent workers over a 2-year construction period and is similar to the Oklahoma estimate. Using the Oklahoma estimate for Texas in this EIS is reasonably conservative.)

energy generation facilities. Worker injury and fatality rates would be expected to be lower if the wind capacity build-out were less than 4,550MW.

Based on BLS data reported nationally within the construction industry (BLS 2012a), there were 3.7 non-fatal recordable incidents per 100 full-time equivalent workers annually. Using the BLS data, based on a full-time equivalent construction workforce (16 wind energy generation facilities) of approximately 2,744 workers working for 2 years, it is estimated there would be approximately 203 non-fatal recordable incidents associated with the construction of the wind energy generation facilities. Also, BLS data reported nationally within the construction industry (BLS 2012b) identify 9.9 fatal incidents per 100,000 full-time equivalent workers. Using the representative construction workforce of 2,744 workers, it is estimated that there would be approximately 0.5 fatalities during a 2-year construction phase.

Operational accident statistics for the 16 wind energy generation facilities is based on BLS data reported nationally within the electric utility industry (BLS 2012a), which identifies 2.8 non-fatal recordable incidents per 100 full-time equivalent workers. Using the BLS data, based on a full-time equivalent operations workforce of approximately 224 people working over the long-term operational phases of the 16 wind energy generation facilities associated with the maximum 4,550MW build-out capacity, it is estimated there would be approximately 6.3 non-fatal recordable incidents annually. Also, BLS data reported nationally within the utility industry (BLS 2012b) identify 2.5 fatal incidents per 100,000 full-time equivalent workers. Using the operations workforce of 224 workers, it is estimated that there would be approximately 0.006 fatalities annually during the combined operations and maintenance phases of the 16 wind energy generation facilities.

Because of the expected establishment of adequate access controls that prevent entry to hazardous areas by unauthorized individuals, the majority of adverse impacts during construction, operations and maintenance, and decommissioning of wind energy generation facilities have the potential to impact only the respective workforces of those phases (WAPA and USFWS 2013). A primary physical safety hazard of wind turbines occurs if a rotor blade fails and pieces are ejected. Ejection could occur as a result of rotor overspeed, although such occurrences have been extremely rare and have happened mostly with older and smaller turbines (Hau 2000). A related issue, ice throw, can occur if ice builds up on the turbine blades. Although weather conditions relatively near the ground, where the blades would be working, rarely result in ice buildup on the blades, such buildup can and has occurred (WAPA and USFWS 2013). The portion of the ROI in Oklahoma and the Texas Panhandle experience extreme temperature changes, especially in the winter months, from cold fronts moving west to east after crossing the Rocky Mountains. In most instances, ice pieces simply fall from the blade as the air temperature warms and land on the ground near the base of the structure. However, ice pieces as large as 2.2 pounds have been found several hundreds of feet from the structure base (WAPA and USFWS 2013). The extent of impacts from these physical hazards and component failures would typically remain within the wind generation facility site or transmission line ROW, but could extend beyond in extreme cases.

Wind energy generation facility development has the potential to result in health and safety impacts through the handling and use of hazardous materials and the potential to disturb existing known or unknown contaminated sites during construction in the vicinity of WDZs. The types of impacts that may occur are the same as those described for the Project and are considered temporary and minor.

Potential wind energy generation facility development may be located in areas where airports and airstrips are located in the vicinity, which could cause added hazards to workers and the public, aircraft occupants, and wind energy generation facility components from air operations and possible collisions with structures. Wind energy generation facility use of helicopters during construction and operation could cause added risk to occupants, personnel on the ground, and facility structures if a collision were to occur. Table 3.16-7 in Section 3.16 identifies airports or airstrips within or in close proximity to the WDZs. Additionally, potential wind energy generation areas are located within agricultural areas where aerial application of pesticides, herbicides, or fertilizers is a common practice for some crops. Downwind turbulence from rotor airstreams may also cause potential hazards to lighter aircraft (e.g., small private aircraft, aerial spraying aircraft, or helicopters) operating at low altitudes in the area of wind energy generation facilities (Airspace & Safety Initiative 2013).

Fire hazards and natural events and disasters such as severe weather (e.g., tornadoes, ice storms, and flooding), and ground instabilities (e.g., earthquakes) in the vicinity of potential wind energy generation facility developments pose the same types of risks and hazards to workers and members of the public as those described for the transmission Project. Severe weather is known to occur in the WDZs.

Shadow flicker and blade glint and glare are not concerns during construction of wind farm facilities, although operating the wind turbines could cause impacts from such phenomena. Shadow flicker and blade glint and glare would not be an issue during cloudy periods or when turbines are not operating. While there have been studies that have found that shadow flicker may result in the potential for epileptic seizures for those suffering from photosensitive epilepsy (Bos et al. 2013), the AWEA has refuted that finding, noting that “shadow flicker from wind turbines occurs much more slowly than the ‘light strobing’ associated with seizures” (AWEA 2009). One study (Harding et al. 2008) reported that flickers with a frequency greater than 3 hertz could pose a potential for inducing photosensitive seizures, i.e., a light flashing at a rate of more than 3 times per second. The American Epilepsy Foundation reports that lights flashing in the range of 5 to 30 hertz are most likely to trigger seizures (Epilepsy Foundation 2013). A wind turbine with three blades would have to make a full revolution every second (or 60 revolutions per minute) to reach a frequency of 1 hertz; however, large turbines (like the ones likely for the connected action) operate at 18–45 revolutions per minute or 0.3–0.75 hertz (Bos et al. 2013).

Intentional destructive acts most likely to impact the construction of the wind energy generation facilities are theft and vandalism, which generally pose lower safety risks to individuals but could cause temporary disruptions to electrical service. Wind energy generation facilities are generally designed and constructed to minimize the potential for their destruction or displacement. For example, countermeasures such as regular inspections, security patrols, fencing, signs, and video cameras are commonly used to deter or prevent theft, vandalism, and unauthorized access. Although intentional destructive acts could still occur, implementation of these preventative measures would discourage perpetrators and minimize the potential for such events (Clean Line 2014a).

3.8.5.8.2 Optima Substation

The health and safety impacts associated with the future Optima Substation would be similar to the impacts described for other Project components, including other converter stations and associated transmission lines and components; however, the addition of this substation is anticipated to have a smaller potential for effects due to the relatively smaller scale of the future Optima Substation compared to other substations associated with the Project. There would also be fewer construction and operations workers and therefore lower probabilities for injuries and fatalities.

3.8.5.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Interconnection of the Project with TVA's transmission grid would require construction of approximately 37 miles of new 500kV transmission line in western Tennessee and upgrades to approximately 350 miles of existing transmission lines, mostly in central and western Tennessee (as described in Section 2.5.2). Modifications to several substations also would be required. TVA has identified the types and general sizes (e.g., lengths of transmission lines) of upgrades that would be affected by the Project, but has not yet identified their specific locations.

The required TVA upgrades are anticipated to have a similar but smaller potential for health and safety effects than the Project because the upgrades would involve similar activities and workforces and cover a smaller total area, which would likely require less time to construct, potentially resulting in less risk exposure time for workers. TVA would implement measures similar to those listed in Section 3.8.5.1 to minimize or avoid these effects.

3.8.5.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not proceed. No impacts to worker and public health and safety or from intentional destructive acts would occur.

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3.9 Historic and Cultural Resources

3.9.1 Regulatory Background

The federal and state requirements that address identifying, evaluating and considering mitigation measures for cultural and historic resources are identified in Table 3.9-1 and are discussed below.

Table 3.9-1:
Key Statutes and Regulations Related to Historic and Cultural Resources

Jurisdiction	Statute	Legal Code Citation	Key Historic/Cultural Provisions
Federal actions and undertakings	National Environmental Policy Act of 1969, as amended (NEPA)	42 USC §§ 4321–4370 (implementing regulations: 40 CFR Parts 1500–1508) DOE NEPA implementing regulations (10 CFR Part 1021)	Federal law requires evaluation of the potential impacts of major federal actions on historic and cultural resources as a component of the human environment.
	National Historic Preservation Act of 1966, as amended (NHPA)	16 USC § 470 et seq. (implementing regulations: 36 CFR Part 60 and 36 CFR Part 800)	Federal law requires federal agencies to consider the effects of a federal undertaking on NRHP-listed and NRHP-eligible properties.
Federal and tribal lands	Archaeological Resources Protection Act of 1979, as amended (ARPA)	16 USC § 470 aa–mm (implementing regulations: 36 CFR Part 296)	Federal law that prohibits unauthorized collection, excavation of or damage to archaeological resources on federal and tribal lands.
	Native American Graves Protection and Repatriation Act of 1990, as amended (NAGPRA)	25 USC §§ 3001–3013 (implementing regulations: 43 CFR Part 10)	Federal law that protects Native American human remains, funerary objects, and items of cultural patrimony found on federal and tribal lands.
	American Indian Religious Freedom Act	42 USC § 1996	Federal law that protects and preserves for American Indians their inherent right of freedom to believe, express, and exercise traditional religions, including access to sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites.
	Cultural and Heritage Cooperation Authority[1]	25 USC §§ 3051–3057	Authorizes Secretary of Agriculture to ensure access to National Forest land by Indians and Indian Tribes for traditional and cultural purposes; authorizes reburial of human remains and cultural items on National Forest land; and prohibits unauthorized disclosure of information regarding reburial sites and locations of sites.
Arkansas public lands	Arkansas Antiquities Act of 1967, as amended	ACA Chap. 13-6-301–13-6-308	Prohibits unauthorized excavation on public lands in Arkansas; specifies excavation and reporting standards; provides penalties for violations; discourages excavations on private lands except in accordance with the provisions and spirit of the act.
Arkansas public and private lands and waters	Arkansas Grave Protection Act of 1991, as amended	ACA Chap. 13-6-401–13-6-409	Protects all human burials and human skeletal burial remains from desecration, without reference to ethnicity, cultural or religious affiliation, or date of burial; establishes a permit system for legitimate excavation; provides penalties for violations; specifies provisions apply to state and federal agencies as well as private individuals and firms.

Table 3.9-1:
Key Statutes and Regulations Related to Historic and Cultural Resources

Jurisdiction	Statute	Legal Code Citation	Key Historic/Cultural Provisions
Historic preservation reviews in Arkansas	Arkansas Historic Preservation Program (AHPP) Act of 1977, as amended	ACA Chap. 13-7-101–13-7-111	Establishes the AHPP; authorizes cooperation with the Arkansas Archaeological Survey (AAS); assigns AHPP and AAS responsibilities for administration of state role in NHPA.
Oklahoma public lands	Oklahoma Antiquities Law of 1985	53 OS 361	Prohibits unauthorized excavation on public lands in Oklahoma; specifies excavation and reporting standards; provides penalties for violations.
Oklahoma public and private lands and waters	Oklahoma Burial Desecration Law of 1987, as amended	21 OS 1168.0–1168.6	Protects all human burials, skeletal remains, and burial furniture from desecration; establishes a permit system for legitimate excavation; provides penalties for violations; specifies provisions apply to state and federal agencies as well as private individuals and firms.
Historic preservation reviews in Oklahoma	Oklahoma State Register of Historic Places Act of 1983	53 OS 351–355	Designates the Executive Director of the Oklahoma Historical Society (OHS) as the State Historic Preservation Officer and directs OHS to work with the federal government and other states concerning matters of historic preservation; establishes a State Register of Historic Places.
Texas public lands	Antiquities Code of Texas	9 TX NRC 191 (implementing regulations at 13 TX AC 24–26)	Protects archaeological and historic sites on state and local public property and establishes the designation of State Antiquities Landmarks.
Cemeteries in Texas	Texas Cemetery Law	8 TX H&SC Chap. 711 (implementing regulations at 13 TX AC 22)	Cemeteries protected from desecration; a person who discovers an unknown or abandoned cemetery shall file notice of the cemetery with the county clerk of the county in which it is located.
Historic preservation reviews in Texas	Texas Historical Commission Act	4 TX GC Chap. 442 (implementing regulations at 13 TX AC 2)	Established the Texas Historical Commission; defines its purpose, powers, and duties; assigns Commission responsibility for administration of state role in NHPA.
Tennessee public lands and waters	Tennessee Archaeology Code	TCA 11-6-101–11-6-106	Establishes the Tennessee Division of Archaeology; protects archaeological sites on public lands and waters from vandalism and unauthorized excavation.
Graves and cemeteries in Tennessee	Tennessee Archaeology Code	TCA 11-6-107 and 11-6-116–11-6-119	Requires notification to Tennessee Division of Archaeology when human remains are discovered on public or private lands; provides for notification of Indian Tribes when Native American human remains are excavated and grants Native American observers the privilege of presence during such excavations; provides for repatriation and burial.
Historic cemeteries in Tennessee	Tennessee Criminal Code	TCA 39-17-311–39-17-312	Protects cemeteries from desecration and the unauthorized disinterment of human remains.
Historic preservation reviews in Tennessee	Tennessee State Code: State Historian and Historical Commission	TCA 4-11-111	Provides that state agencies consult with Tennessee Historical Commission prior to altering or demolishing state buildings and further provides that Commission staff shall assist agencies, institutions and entities in determining if property is or may be of historical, architectural, or cultural significance.

1 Only relevant to National Forest land.

ACA—Arkansas Code Annotated; OS—Oklahoma Statutes; TCA—Tennessee Code Annotated; TX AC—Texas Administrative Code; TX GC—Texas Government Code; TX H&SC—Texas Health and Safety Code; TX NRC—Texas Natural Resources Code

3.9.1.1 Federal Requirements

For purposes of this EIS, the major federal requirements addressing, identifying, evaluating, and mitigating impacts to cultural and historic resources are in NEPA and the NHPA. These two federal laws are discussed below.

3.9.1.1.1 National Environmental Policy Act

NEPA is a federal law that requires all federal agencies to consider the potential environmental impacts of their proposed major federal actions (42 USC § 4332(C)(i)). The CEQ implementing regulations for NEPA require that EISs discuss the potential environmental consequences to historic and cultural resources (40 CFR 1508.8). Historic and cultural resources under NEPA cover a wide range, including collections, sacred sites, and non-National Register of Historic Places (NRHP)-eligible sites that may be affected by major federal actions that may include activities entirely or partially financed, assisted, conducted, or approved by federal agencies. NEPA's focus is on the environment of the area(s) to be affected by the alternatives under consideration.

In December 2012, DOE published the NOI to prepare an EIS to analyze the potential environmental impacts of the Project. Several of the scoping comments received in response to this NOI addressed potential effects of the Project on specific cultural resources and/or historic properties, including burial sites and a ceremonial ground important to two Tribes, the Honey Springs Battlefield National Historic Landmark identified in consultation with the Oklahoma SHPO, and the potential for effects to portions of the Trail of Tears identified by the NPS.

3.9.1.1.2 National Historic Preservation Act

Section 106 of the NHPA, (16 USC § 470(f)) requires federal agencies to take into account the effects on historic properties of undertakings the agencies carry out, assist, fund, or permit and to provide the ACHP a reasonable opportunity to comment on such undertakings. A federal undertaking is defined as a decision involving federal expenditure of funds or issuance of permit, license, or other approval. Under NHPA, historic properties include any prehistoric or historic district, site, building, structure, or object that is included in or eligible for inclusion in the NRHP. Historic properties of traditional religious and cultural importance to Indian Tribes and Native Hawaiian organizations may also be determined to be eligible for inclusion in the NRHP. The ACHP's NHPA implementing regulations (36 CFR Part 800) describe the process for compliance with Section 106 and provide the steps a federal agency must take to determine the Area of Potential Effects (APE) of a proposed undertaking, identify historic properties within the APE, assess potential effects of the proposed undertaking on historic properties, and consult with Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking related to the Project and the SHPOs of Arkansas, Oklahoma, Tennessee, and Texas to consider measures to avoid, minimize, or mitigate any adverse effects of the undertaking on historic properties. These steps are carried out in consultation with SHPOs, Tribal Historic Preservation Officers (THPOs) or representatives from Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking related to the Project, and other consulting parties (36 CFR 800.2). The DOE has determined that participation in Clean Line's Project is an undertaking under the NHPA. Implementing regulations for both the NEPA and the NHPA encourage agencies to integrate the reviews of potential Project impacts that are required under each law (40 CFR Parts 1500.2(c) and 1502.25, for NEPA; 36 CFR Parts 800.8(a) and 800.8(c), for NHPA). DOE informed the ACHP by letter dated November 20, 2012, that pursuant to the NHPA implementing regulation at 36 CFR 800.8(c), it intended to use substitution, under which DOE is authorized to use the NEPA process and documentation required for the preparation of the EIS for the Plains & Eastern Clean Line Project to comply with Section 106 of the NHPA in lieu of the procedures set forth in 36 CFR 800.3 through 800.6.

In November 2012, DOE invited a number of federal agencies to participate in the Section 106 process and related consultations in this combined NEPA/NHPA evaluation. The following agencies are participating as consulting parties in the Section 106 process: BIA, NPS, USFS, USFWS, USACE, and TVA. DOE is the lead agency for the Section 106 consultation process as indicated in DOE's Memoranda of Understanding with the above-listed federal agencies.

DOE intends to develop a Programmatic Agreement (PA) pursuant to 36 CFR 800.14(b) to address DOE's obligations under NHPA Section 106, including consultation (with Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking related to the Project and the SHPOs of Arkansas, Oklahoma, Tennessee, and Texas), resource identification and evaluation, assessment of effects, and resolution of effects, including avoidance, where practicable, and mitigation. In the event that the PA is not fully executed, DOE will comply with 36 CFR Part 800, subpart B. Development of a PA under 36 CFR 800.14(b) is appropriate for the Project because the likely effects on historic properties are multi-state and regional in scope, because of the complex nature of the undertaking, and because effects on historic properties cannot be fully determined prior to approval of the undertaking. In such situations, the ACHP regulations allow development of a PA to address the identification of historic properties and resolution of adverse effects in a phased approach (36 CFR 800.14(b)). DOE will continue to consult with ACHP with the intention of developing a PA to fulfill DOE's Section 106 consultation obligations (36 CFR 800.8(c)).

Section 106 consultation for the Project on the PA is ongoing. On February 19, 2014, the ACHP notified the DOE that ACHP would participate in consultation to develop a PA for the referenced undertaking given the undertaking's potential to impact historic properties and the potential for procedural questions because DOE proposes to use the substitution process in the ACHP regulations (36 CFR 800.8(c)). Consultation was initiated with the SHPOs from Arkansas, Oklahoma, and Tennessee by DOE in November 2012 when DOE informed the SHPOs about its intention to integrate NEPA and NHPA Section 106 consultation. In January 2013, DOE designated Clean Line as a non-federal consulting party to initiate the Section 106 consultation with the SHPOs. DOE notified the SHPOs at that time of Clean Line's status and reaffirmed that DOE would remain responsible for government-to-government consultation with Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking related to the Project. After the NEPA public scoping period ended in March 2013, DOE sent a letter to the Oklahoma, Arkansas and Tennessee SHPOs in April 2013, updating them on the status of DOE's public scoping process and tribal consultation. DOE met with the Oklahoma, Arkansas, and Tennessee SHPOs in June 2013. DOE initiated consultation with the SHPO from Texas in January 2014 in a letter that informed the SHPO about DOE's intention to integrate NEPA and NHPA Section 106 consultation.

As part of the Section 106 process, DOE also initiated government-to-government consultations with Indian Tribes in accordance with 36 CFR 800.2. DOE identified Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking related to the Project and initiated consultation with these Indian Tribes in January 2013 and with the Osage Nation in late June 2013. Indian Tribes consulted as of October 2014 are listed in Table 3.9-2. DOE sent a second letter in April 2013 following the NEPA public scoping period to provide updates on the status of the NEPA process and NHPA Section 106 and government-to-government consultation. In July 2013, DOE sent a third letter to Indian Tribes in which DOE requested a meeting to discuss the potential development of a PA. As of September 2014, The Absentee-Shawnee Tribe of Oklahoma, the Chickasaw Nation, the Choctaw Nation, the Kaw Nation, the Iowa Tribe of Oklahoma, the Muscogee (Creek) Nation, the Osage Nation, the Quapaw Tribe of Oklahoma, the Sac and Fox Nation, the Thlopthlocco Tribal Town, the United Keetowah Band of Cherokee, and the Wichita and Affiliated Tribes will continue to consult on this undertaking.

Table 3.9-2:
Indian Tribes Consulted under NHPA Section 106

Tribe	Tribe	Tribe
Absentee Shawnee Tribe	Delaware Tribe of Indians	Plains Apache Mayanahonah
Alabama Quassarte Tribal Town	Eastern Band of Cherokee Indians	Quapaw Tribe
Arkansas Riverbed Authority	Iowa Tribe of Oklahoma	Sac and Fox
Caddo Nation	Kaw Nation	Santee Sioux Nation
Chickasaw Nation	Kialegee Tribal Town	Seneca Cayuga Tribe of Oklahoma
Choctaw Nation of Oklahoma	Kiowa	Southern Arapaho and Southern Cheyenne
Cherokee Nation	Modoc Tribe	Thlopthlocco Tribal Town
Comanche	Muscogee (Creek) Nation	Tonkawa
Delaware Nation	Osage Nation	Wichita and Affiliated Tribes

DOE continues to reach out to local governments and historical societies to inquire regarding their interest in participating in the Section 106 consultation and PA development process (if appropriate). To date, no individuals or organizations have requested consulting party status under 36 CFR 800.3(f).

3.9.1.1.3 Other Federal and State Laws

Other federal laws that concern the evaluation and management of historic and cultural resources within the Project ROI include Archaeological Resources Protection Act (ARPA), Native American Graves Protection and Repatriation Act (NAGPRA), American Indian Religious Freedom Act (AIRFA), and Cultural and Heritage Cooperation Authority, which only applies to National Forest lands (Table 3.9-1). Very little of the Applicant Proposed Route and only one alternative route, HVDC Alternative Route 4-B, crosses National Forest land. ARPA (16 USC § 470) protects archaeological sites and resources on federal and tribal lands from unauthorized damage or impacts, establishes procedures for obtaining permits for archaeological excavation on federal and tribal lands by qualified individuals, and sets criminal and civil penalties for violations of the law. NAGPRA (25 USC § 3001–3013) protects Native American human remains, funerary objects, and other items of cultural patrimony found on federal and tribal lands and requires that such materials are treated respectfully if encountered on federal or tribal lands during Project development, construction, operation, or decommissioning. AIRFA (42 USC § 1996) protects and preserves for American Indians their inherent right of freedom to believe, express, and exercise their traditional religions, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. No tribal lands, as defined by 25 CFR 169.1(d), outside of the Arkansas River are crossed by the Project. The Project would cross Arkansas River at a point which is administered by the Arkansas Riverbed Authority, an entity created jointly by the Chickasaw, Choctaw and Cherokee Nations to administer the tribally owned stretch of the Arkansas River between Muskogee Oklahoma, and Fort Smith, Arkansas.

State laws and regulations complement federal law on historic and cultural resources. These laws and regulations vary by state (Table 3.9-1). In general, however, all four states in which the Project would be located have laws protecting marked and unmarked graves and cemeteries, and all four states assert control over archaeological and historic resources on state and local public lands. Administrative rules or other standards issued by the respective SHPOs provide specifications and guidance for archaeological and historic architectural surveys, particularly when such studies are completed as part of Section 106 consultations.

3.9.2 Data Sources

To date, evaluation of cultural resources has relied upon background reviews of existing inventories and related information, primarily from SHPO and other state-maintained files. No Project-specific field surveys have been conducted; instead, this analysis relies on data compiled as part of studies, surveys, and reviews that were completed for unrelated projects independent of this EIS in portions of the ROI.

The Applicant and its contractors, SWCA Environmental Consultants (SWCA) and Panamerican Consultants, assembled data on cultural resources from various state agencies in the ROI for the Project. These data and the reports developed from them (Clean Line 2013, 2014) serve as the principal sources of information for the description of the affected environment and the analysis of potential effects related to the Project. Data have been assembled from the following state agencies, some of which are SHPOs (Clean Line 2013):

- Arkansas Archaeological Survey, University of Arkansas, Fayetteville
- Arkansas Historic Preservation Program, Little Rock
- Oklahoma Archaeological Survey, University of Oklahoma, Norman
- Oklahoma State Historic Preservation Office, Oklahoma City*
- Tennessee Division of Archaeology, Nashville
- Tennessee Historical Commission, Nashville
- Texas Archaeological Research Laboratory, University of Texas, Austin
- Texas Historical Commission, Austin

In addition to the aforementioned state agency sources, SWCA also examined NRHP online records from the NPS. DOE also conducted its own review of the NRHP-online records (NPS 2014b) for this EIS.

To develop the background sections of their report on the Project, SWCA also reviewed standard scholarly treatments and selected historic preservation planning documents from pertinent SHPOs. DOE is conducting an ongoing consultation with Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking related to the Project to identify tribal cultural resources that could be affected by the Project. Clean Line in 2011 and 2012 conducted outreach to Indian Tribes in the vicinity of the Project.

The information reported in this section is the best available at the present time concerning historic and cultural resources. DOE has independently reviewed information provided by the Applicant. Additional information on historic and cultural resources that could be impacted by the Project will be obtained through field surveys to be conducted prior to construction.

3.9.3 Region of Influence

As described in Section 3.1.1, this EIS defines the area potentially affected by the Project as the ROI. DOE intends to define the APE (see Section 3.9.1.1.2), which is the geographic area within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, in the PA. The extent of the APE is influenced by the scale and nature of an undertaking and may be different for different types of effects caused by the undertaking.

For historic and cultural resources, the ROI for the Project is as defined in Section 3.1.

For purposes of this EIS, the ROI for potential visual effects to historic and cultural resources is defined as follows:

- A 1-mile-wide corridor along the Applicant Proposed Route or along the HVDC alternative routes, and the AC collection system routes (i.e., a 0.5-mile zone on either side of the centerline).
- Each converter station siting area and AC interconnection siting area with the area extending outward 0.5 mile.
- A 1,000-foot corridor ROI (500 feet on either side of the centerline of the Applicant Proposed Route and HVDC alternative route) is used to characterize and assess potential effects on archaeological sites, which are largely belowground and therefore less likely to experience visual effects; the larger ROI is used to characterize and assess potential effects on aboveground historic properties and historic routes. It is possible that some archaeological sites could have aboveground expressions, but for the purpose of this analysis, archaeological sites were evaluated in the 1,000-foot corridor ROI.

The ROI for historic and cultural resources for wind energy development, the future Optima Substation, and TVA upgrades are as described in Section 3.1.

3.9.4 Affected Environment

The Project encompasses a geographic transect stretching approximately 720 miles across central North America. This transect extends from the grasslands of the High Plains on the west to the forested eastern flank of the Mississippi Valley on the east. It contains a diverse range of climatic zones, terrain, flora, and fauna whose character has gradually altered with global climatic change and with the effects of human activities on local environments over a period of more than 12 millennia. These environmental factors in turn helped shape the different cultures of people who lived in various places at various times throughout central North America in which the ROI is located.

Human occupation in the region began with the arrival of the early ancestors of modern Native Americans, who are known to archaeologists as Paleoindians. Paleoindians specialized in hunting large now-extinct Pleistocene megafauna, and herd animals such as bison, and are believed to have travelled over wide regions to secure their livelihood. With environmental change at the end of the last glacial epoch, forested lands became more widespread and environmental stresses related to warming and drying climatic conditions appeared. While the Plains dwellers of the western end of the Project region continued to depend on bison and other herd animals, further east, Native American peoples developed new subsistence strategies that aimed to exploit the more solitary animals of forests and woodlands, as well as abundant resources found in and around rivers, ponds, and wetlands. This Archaic period, as it is known, lasted for many thousands of years, and in some places Native Americans still practiced what were essentially Archaic period lifeways up to the disruptions caused by the arrival of Euroamerican explorers, traders, and settlers.

Some two to three thousand years ago, innovations originating among the Native Americans of Mexico and Central America reached the Southeast and Plains regions of the United States. Key innovations included the practice of horticulture involving cultivation of corn, beans, and squash, and the manufacture of earthenware pottery. These new practices mark the emergence of the Woodland period. In the eastern part of the ROI, the rise of horticulture was probably one factor in the development of large villages and towns with increasingly complex social and political organizations, which characterize the final period of prehistory in the eastern Arkansas-western Tennessee region, known as the Mississippian period. To the west, a cultural tradition known to archaeologists as Plains Villager appeared. This tradition was characterized by small semi-permanent settlements and a mixed hunting, gathering, and horticultural way of life; social complexity was less intensely developed than in the Mississippian cultures to the east.

Beginning in the mid-sixteenth century, European explorers started traversing the region. Traders and settlers followed, generally moving west up major valleys from the Mississippi River, causing vast disruption to the traditional cultures and ways of life of the Native American peoples of the region. In the nineteenth century, policies of the federal government relocated many Tribes from the eastern United States into Oklahoma, parts of which then comprised Indian Territory. As the United States grew in population and economic and industrial power, the Project region was drawn into the modern nation-state. Dates of statehood indicate the historical trajectory of this process: Tennessee became a state in 1796, followed by Arkansas in 1834, and Oklahoma in 1907.

Historic and cultural resources preserve traces of this long history for archaeological study and illustrate it for modern Americans. In general, traces of the Native American past prior to the arrival of Euroamericans (conventionally referred to as the prehistoric period of human history in North America) are largely preserved belowground as archaeological sites. Extant, mostly aboveground, buildings and structures, in contrast, serve as important witnesses to colonial and post-colonial American history, mostly of the nineteenth and twentieth centuries, and these standing structures are complemented by archaeological sites of the period.

The discussion below uses only counts of archaeological resources in the Project ROI to maintain the confidentiality of the geographic locations of the sites provided by the SHPOs or state archaeological surveys. Site location confidentiality helps to protect sites from vandalism.

The ROI contains more than 100 inventoried archaeological sites and a roughly similar number of architectural resources. Most cultural resources have been identified only, and their integrity, significance, and potential eligibility for listing in the NRHP remain unevaluated. However, the ROI also contain 13 identified historic properties that are listed on the NRHP. Figure 3.9-1 in Appendix A shows the NRHP sites that are located within Regions 1 through 7. Unlike the majority of inventoried cultural resources in the ROI whose integrity, significance, and eligibility remain unevaluated, these 19 properties have a clearly established level of cultural or historical significance and are identified individually in Tables 3.9-3 and 3.9-12 and in the text below.

Table 3.9-3:
NRHP-Listed Properties in the 1-mile ROI for the Project—All Regions

Region	Project Segment(s)	Property Name	NRIS No.	Location	Distance from Centerline (miles)
1	AC Collection Line NW 2	Tracey [or Tracy] Wood-Frame Grain Elevator[1]	83002137	Muncy, Texas County, Oklahoma	0.03
3	AR 3-C and AR 3-D	Oktaha School	78002242	Oktaha, Muskogee County, Oklahoma	0.29
3	AR 3-C and AR 3-D	Honey Springs Battlefield NHL	70000848	Oktaha vicinity, Muskogee and Macintosh Counties, Oklahoma	0.10
4	APR Link 6	Mulberry River Bridge	06001272	Pleasant Hill vicinity, Crawford County, Arkansas	0.28
4	AR 4-B	Butterfield Overland Mail Route—Lucian Wood Road Segment	09000771	Cedarville vicinity, Crawford County, Arkansas	0.08

Table 3.9-3:
NRHP-Listed Properties in the 1-mile ROI for the Project—All Regions

Region	Project Segment(s)	Property Name	NRIS No.	Location	Distance from Centerline (miles)
4	AR 4-E	Lutherville School	99000228	Lamar vicinity, Johnson County, Arkansas	0.09
4	AR 4-E	Munger House	96001174	Lutherville vicinity, Johnson County, Arkansas	0.05
5	APR Link 9	William Henry Watson Homestead	91001308	Denmark Township, White County, Arkansas	0.34
5	AR 5-B	Charlie Hall House	05000492	Twin Groves vicinity, Faulkner County, Arkansas	0.05
5	AR 5-B, AR 5-E, and AR 5-F	New Mt. Pisgah School	91001331	Mt. Pisgah vicinity, White County, Arkansas	0.29
5	AR 5-C, APR Link 5, and APR Link 6	Wesley Marsh House	91001328	Letona vicinity, White County, Arkansas	0.34 mi (AR 5-C and APR Link 5); 0.41 mi (APR Link 6)
7	AR 7-A	Highway A-7 Bridges Historic District	09000318	Marked Tree Vicinity, Poinsett County, Arkansas	0.0 mi (crosses)
7	AR 7-A	Nodena Site NHL	66000201	Wilson Vicinity, Mississippi County, Arkansas	>0.10

NRIS—National Register Information System.
NHL—National Historic Landmark
1 Examination of aerial imagery available from Google Earth indicates that the Tracey Wood-Frame Grain Elevator is no longer extant. Field survey would be required to verify its disappearance.
Source: NPS (2014b), OKSHPO (2014b)

In addition to the historical dimension of the resources present in the ROI, there may be additional resources including burial sites, individual homestead allotments, and ceremonial grounds important to present-day Indian Tribal identity or lifeways, or cultural significance. Tribal resources conceptually overlap in part with archaeological and architectural resources, but tribal resources have not yet been formally identified or documented. As part of the process of identifying and evaluating historic and cultural resources in this region, and as noted above, DOE is conducting ongoing consultation with Indian Tribes. Concerns for specific burial and ceremonial ground areas have been expressed in consultation meetings in relation to the ROI.

Assessment of effects (including visual effects) on historic properties is based in part on the evaluation of integrity and is related to the characteristics of each property that make it NRHP-eligible. According to the NRHP guidelines, integrity is defined as the ability of an historic property to convey its own significance; evaluations of integrity must always be grounded in an understanding of a property's physical features and whether they remain sufficiently intact to convey its significance. A historic property's integrity includes seven unique aspects: location, setting, design, materials, feeling, workmanship, and association. Based on these aspects, the types of sites considered visually sensitive include, but are not limited to, National Historic Monuments, Districts, Landmarks, and Trails; sites eligible under criteria A, B, or C and Traditional Cultural Properties (36 CFR 800.5). In the Section 106 consultation process, the lead federal agency typically makes a determination about the NRHP eligibility of each identified historic property within the APE of the undertaking; the pertinent SHPO provides concurrence, as appropriate, with the agency's determinations.

3.9.5 Regional Description

Geographic and cultural features relevant to the characteristics and distribution of historic and cultural resources are described by region in the sections below. The region names and the Applicant Proposed Route and HVDC alternative routes by region are listed in Table 2.4-1.

3.9.5.1 Region 1

The western end of Region 1 is the location of the AC collection system centered in Texas County, Oklahoma, and including areas in adjoining counties in Oklahoma and Texas. In addition, Region 1 includes the Applicant Proposed Route, HVDC alternative routes, and the Oklahoma Converter Station.

Region 1 is situated in western Oklahoma, including the eastern and central portions of the Oklahoma Panhandle. It also includes the north-central border region of the adjoining Texas Panhandle. The region is part of the Plains culture area as defined by ethnographers for indigenous Native American peoples of the late prehistoric and historical periods (after roughly 1650 AD) (DeMallie 2001). The Oklahoma Archaeological Survey (OAS) places the region within its Southern Plains Adaptations research region for Native American archaeology (OAS 2011). Region 1 spans portions of two historic preservation planning and management regions defined by the Oklahoma State Historic Preservation Office (OKSHPO): OKSHPO Region 1 (the Oklahoma Panhandle) and OKSPHO Region 2 (Northwestern Oklahoma) (OKSHPO 2014a). In Texas, Region 1 is part of the Texas Historical Commission's Archaeology Region 1 and its Plains Trail heritage tourism region (Texas Historical Commission 2014a, 2014b). Texas archaeologists and historians identify Region 1 as part of the Panhandle region of the state (Perttula 2004, Figure 1.1; Rathjen 2010).

Geographically, Region 1 lies within the High Plains physiographic province (Wedel and Frison 2001, Figure 1). It is characterized by level and irregular, rolling to broken plains that grade into dissected canyons, escarpments, hills, buttes, terraces, and dunes. There are scattered playas on the plains of the region. The natural vegetation is mostly short grass prairie (Griffith et al. 2004; Woods et al. 2005). The region today is primarily agricultural and is dominated by cattle ranching. The archaeological record of the region spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small pithouse villages of Native American horticulturalists in late prehistory to the remains of dugouts, ranches, and farmsteads of late nineteenth- and twentieth-century non-Indian settlers, ranchers, and farmers (Clean Line 2013). According to the OAS (2011), prehistoric, protohistoric, and early historic period archaeological sites in the region are "characterized by the remains of special activity sites, camps, and villages of Native Americans whose lives were focused around the bison (buffalo)." Historic property types associated with the occupation of the region by Euroamericans and other non-Indian groups from the late nineteenth century onwards include townsites; commercial buildings and structures; non-commercial and governmental buildings; homesteads, farms, and ranches; churches; schools; and cemeteries (Smith 1986a). Such property types occur both as extant standing structures and as archaeological sites.

No historic or cultural resources have been identified within the Oklahoma Converter Station Siting Area or associated AC Interconnection Siting Area (Clean Line 2013). Information about historic and cultural resources in the AC collection system and HVDC transmission facilities in Region 1 is presented in the following sections.

3.9.5.1.1 Region 1 AC Collection System

The proposed AC collection system in Region 1 primarily occupies vast upland regions of the Oklahoma and Texas Panhandles. Terrain in the region is varied, and climate is semi-arid. Inventoried archaeological sites are few in comparison to the acreages involved. Nonetheless, available information shows that archaeological sites typically occur in the vicinity of principal drainages and major tributaries, as well as in the vicinity of terrain features such as escarpments and buttes. Several historic transportation routes cross the area, but no cultural resources have been documented as associated.

The Applicant's initial analysis of potential impacts to historic and cultural resources for the AC collection system routes considered 2-mile-wide siting corridors (the ROI), which represented a combined area of over 440,000 acres. In all, these corridors contain a total of 71 separate sites, but due to overlaps between adjacent 2-mile siting corridors, some of these sites are counted more than once in Table 3.9-4, which shows the numbers of previously inventoried historic and cultural resources associated with the corridors. Among the 71 sites, 46 are prehistoric archaeological sites, 11 are historic period sites, 5 are multicomponent (prehistoric and historic period) sites, and 9 lack a record as to period. Over 80 percent (59 of 71) of the inventoried archaeological sites have not been evaluated for NRHP eligibility. To date, nine of the sites have been determined ineligible for the NRHP, while three are categorized as NRHP-eligible. No previously recorded archaeological sites in the ROI for the AC collection system routes in Region 1 are listed on the NRHP. Prehistoric archaeological site types that may be anticipated within the ROI include open camps, general artifact scatters, isolated burials, and a bison kill sites. Historic archaeological sites may include farmsteads, general artifact scatters, cemeteries (which could also be categorized as historic architectural features), isolated structures, and railroad-related ruins (Clean Line 2013). Only one aboveground historic structure, an NRHP-listed early twentieth-century grain elevator, has been inventoried in the ROI of the AC collection system routes in Region 1. Four historic transportation routes are known in the region, including two railroad lines, a military road, and a cattle trail, and the ROI intersects these historic transportation routes in multiple locations.

Table 3.9-4:
Previously Inventoried Historic and Cultural Resources in the ROI for the AC Collection System Routes in Region 1

		AC Collection System Route												
		E-1	E-2	E-3	NE-1	NE-2	SE-1	SE-2	SE-3	NW-1	NW-2	SW-1	SW-2	W-1
Archaeological Sites														
Prehistoric	Unique[1]	6	0	11	0	1	3	1	5	0	0	0	0	1
	Duplicate[2]	2	5	2	6	2	9	8	7	3	5	3	10	9
	Total	8	5	13	6	3	12	9	12	3	5	3	10	10
Historic	Unique[1]	0	0	2	0	0	0	0	1	0	0	0	0	0
	Duplicate[2]	0	4	0	1	0	2	1	3	2	4	2	2	2
	Total	0	4	2	1	0	2	1	4	2	4	2	2	2
Multicomponent	Unique[1]	0	0	2	0	1	0	0	0	0	0	0	0	0
	Duplicate[2]	0	2	0	0	0	0	0	1	0	2	0	0	0
	Total	0	2	2	0	1	0	0	1	0	2	0	0	0

Table 3.9-4:
Previously Inventoried Historic and Cultural Resources in the ROI for the AC Collection System Routes in Region 1

		AC Collection System Route												
		E-1	E-2	E-3	NE-1	NE-2	SE-1	SE-2	SE-3	NW-1	NW-2	SW-1	SW-2	W-1
Not Specified	Unique[1]	0	0	1	1	0	2	4	0	0	0	0	0	0
	Duplicate[2]	0	0	0	1	0	0	1	0	0	0	0	0	0
	Total	0	0	1	2	0	2	5	0	0	0	0	0	0
Total Archaeological Sites		8	11	18	9	4	16	15	17	5	11	5	12	12
Aboveground Historic Properties[3]														
Inventoried Buildings and Structures		0	0	0	0	0	0	0	0	0	0	0	0	0
NRHP-Listed Properties		0	0	0	0	0	0	0	0	0	1	0	0	0
Total Aboveground Properties		0	0	0	0	0	0	0	0	0	1	0	0	0
Historic Routes, Trails, and Roads[4]		0	3	2	1	0	2	0	2	1	2	0	0	1

1 “Unique” sites are counted only once in this table. They are within the 2-mile siting corridor for only a single collection line.
2 “Duplicate” sites are counted two or more times in this table. They are overlapping portions areas of the 2-mile siting corridors for two or more collection lines.
3 Due to the low number of aboveground historic properties, the duplicate counts do not arise.
4 Trail intersections per 2-mile corridor; includes a combination of several different trails that may intersect a given corridor once or more than once.
Source: Clean Line (2013, Table 3-42B)

3.9.5.1.2 Region 1 HVDC Transmission Facilities

Available information for the proposed transmission line corridors of the Applicant Proposed Route and HVDC Alternative Routes 1-A through 1-D in Region 1 indicates that inventoried prehistoric and historic archaeological sites typically occur along the principal drainages and their major tributaries; these increase in prominence toward the eastern end of the region. Historical settlement was dispersed across the region; documented historic standing structures occur in the western end of the ROI in a clustering that results from the low density of historic properties in Region 1 and the limited extent of survey to date (Clean Line 2013). The clustering is not historically meaningful.

Including duplicate counts, 11 prehistoric archaeological sites and five historic archaeological sites are documented for the ROI associated with the HVDC transmission facilities in Region 1 (Table 3.9-5). None of the sites has been determined to be eligible for or is listed on the NRHP. Documented prehistoric archaeological site types in the ROI include general artifact scatters, open camps, and a bison kill site. Documented historic archaeological site types in Region 1 are farmsteads, along with an isolated structure and an unspecified site type. The Applicant Proposed Route and HVDC alternative routes cross several nineteenth-century cattle trails, military roads, and early railroad lines, but no archaeological sites or standing structures have been recorded as specifically associated with these routes in the region. The ROI for potential visual impacts for the Applicant Proposed Route and HVDC alternative routes includes three buildings that are reported to be eligible for the NRHP (Clean Line 2013).

Table 3.9-5:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 1

	APR	AR 1-A	AR 1-B	AR 1-C	AR 1-D
Archaeological Sites[1]					
Prehistoric	2[2]	7	1	0	12
Historic	2	2	1	0	0
Multicomponent	0	0	0	0	0
Not Specified	0	0	0	0	0
Total Archaeological Sites	4	9	2	0	1
Aboveground Historic Properties[1]					
Inventoried Buildings and Structures	13	0	1[3,4]	1[3, 4]	0
NRHP-Listed Properties	0	0	0	0	0
Total Aboveground Properties	1	0	1	1	0
Historic Routes, Trails, and Roads[1]	6	6	2	2	0

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Includes one site that is counted twice because its location is known only to a half quarter-section, and the identified area is intersected by both Applicant Proposed Route Link 4 and HVDC Alternative Route 1-D.
3 Identified by OKSHPO records as NRHP eligible.
4 Duplicate count. Building or structure occurs in conterminous ROI for HVDC Alternative Routes 1-B and 1-C.
Source: Clean Line (2013, Table 3-9)

3.9.5.2 Region 2

The history of Region 2 includes the Plains culture area as defined by ethnographers for Native American peoples of the late prehistoric and historical periods (after roughly 1650 AD). The OAS (2011) places the region within its Southern Plains Adaptations research region for Native American archaeology (OAS 2011). Region 2 is situated within OKSHPO (2014a) historic preservation planning and management Region 2 (Northwestern Oklahoma).

Geographically, Region 2 lies within the Osage Plains physiographic province (Wedel and Frison 2001, Figure 1). It is characterized by a variety of landforms, including stabilized and active dune fields, gypsum karst terrain, breaks, escarpments, gorges, ledges, canyons, and nearly level prairieland. The natural vegetation of upland areas is predominantly mixed grass prairie. Characteristic soils and hydrological conditions mean that dune and karst areas each support distinct vegetation communities of mixed grasslands, shrubs, and trees. Throughout the region, ravines and stream valleys support woodlands, and woodlands are more extensive to the east, where annual rainfall tends to be greater and less variable (Woods et al. 2005). Cattle ranching dominates the western half of Region 2, and small grain farming is predominant in the eastern half. The archaeological record of Region 2 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small pithouse villages of Native American horticulturalists in late prehistory to the remains of dugouts, ranches, and farmsteads of late nineteenth- and twentieth-century non-Indian settlers, ranchers, and farmers (Clean Line 2013). According to the OAS (2011), prehistoric, protohistoric, and early historic period archaeological sites in the region are "characterized by the remains of special activity sites, camps, and villages of Native Americans whose lives were focused around the bison (buffalo)." Historic property types associated with the occupation of the region by Euroamericans and other non-Indian groups from the late nineteenth century onwards include townsites; commercial buildings and structures; non-commercial and governmental buildings; homesteads, farms, and ranches; churches;

schools; and cemeteries (Smith 1986b). Such property types occur both as extant standing structures and as archaeological sites.

Available information indicates that, in general, prehistoric and historic archaeological sites occur most frequently along the region's principal drainages and their major tributaries, which are more numerous in its central and eastern sections. Historical settlement was dispersed across the region, and the region was crossed by several historical transportation corridors (Clean Line 2013).

Only two archaeological sites have been documented within the ROI in Region 2 (Table 3.9-6), and the available information does not indicate the time period of either. Neither has been determined to be eligible for or is listed on the NRHP. No historic standing structures have been documented in the ROI for potential visual impacts for the Applicant Proposed Route and HVDC alternative routes (Clean Line 2013).

Table 3.9-6:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 2

	APR	AR 2-A	AR 2-B
Archaeological Sites[1]			
Prehistoric	0	0	0
Historic	0	0	0
Multicomponent	0	0	0
Not Specified	0	2	0
Aboveground Historic Properties[1]			
Inventoried Buildings and Structures	0	1	0
NRHP-Listed Properties	0	0	0
Total Aboveground Properties	0	1	0
Historic Routes, Trails, and Roads[1]	9	4	4

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
Source: Clean Line (2013, Table 3-14)

3.9.5.3 Region 3

The history of Region 3 includes the Plains culture area as defined by ethnographers for Native American peoples of the late prehistoric and historical periods (after roughly 1650 AD). The OAS (2011) places the region within its Cross Timbers research region for Native American archaeology (OAS 2011). Region 3 is situated within OKSHPO's (2014a) historic preservation planning and management Regions 2 (Northwestern Oklahoma), 3 (Northeastern Oklahoma), and 6 (Central Oklahoma).

Geographically, Region 3 lies within the Osage Plains and Central Lowland physiographic provinces (Wedel and Frison 2001, Figure 1). "Terrain and vegetation are transitional between the less rugged grass-covered ecoregions to the west and the hilly, oak savanna… to the east" (Woods et al. 2005). It is characterized by rough, undulating, and irregular plains, hills, and typically asymmetrical ridges. The natural vegetation varies from west to east. To the west, the characteristic natural vegetation is prairie grasses with scattered trees and light woodlands, while to the east natural vegetation consists of a mosaic of oak savanna, scrubby oak forest, eastern redcedar, and tall grass prairie.

Modern land use is varied and includes rangeland, cultivated crops, forests, and commercial and residential development. The archaeological record of Region 3 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small pithouse villages of Native American horticulturalists in late prehistory to the remains of dugouts, ranches, and farmsteads of late nineteenth- and twentieth-century non-Indian settlers, ranchers, and farmers (Clean Line 2013). According to the OAS (2011), the prehistoric archaeology of the Cross Timbers region offers a glimpse into the continual adjustments that Native American peoples made to changing environmental conditions over the 12 millennia during which they occupied the area. A variety of prehistoric Native American site types occur, including special activity sites, camps, and villages. From the 1830s, northeastern Oklahoma (OKSHPO Planning and Management Region 3) was the home of the Creek and Cherokee Nations following the forced removal of Native Americans from the eastern states to Indian Territory. The OKSHPO's historic context for historic Native Americans in northeastern Oklahoma identifies 11 associated classes of properties, described as buildings, structures, objects, sites, and districts related to tribal government; spirit life; education; agriculture, ranching, commerce, and industry; pre-railroad transportation; dwellings and home places; townsites; recreation and encampments; health care; military; and the federal Indian Agency (Baird and Gebhard 1991). Historic property types associated with the occupation of the region by Euroamericans and other non-Indian groups from the late nineteenth century onwards include townsites; commercial buildings and structures; non-commercial and governmental buildings; homesteads, farms, and ranches; churches; schools; and cemeteries (Smith 1984, 1986b, 1986c). Such property types occur both as extant standing structures and as archaeological sites.

Available information indicates that, in general, prehistoric and historic archaeological sites occur most frequently along the region's principal drainages and their major tributaries, which are more numerous than in Regions 1 and 2 to the west. Historical settlement was dispersed across the region, and the region was crossed by several historical transportation corridors, including portions of historic U.S. Route 66 (Clean Line 2013). Congress has recognized the national historical significance of Route 66 and encourages preservation of historic properties along it through the NPS's Route 66 Corridor Preservation Program, which provides leadership for a diverse group of public and private stakeholders (NPS 2014a). Oklahoma has completed historic resource surveys of resources associated with the highway within its borders (Anderson et al. 2002; Cassity 2002).

Including duplicate counts, eight archaeological sites have been documented for the ROI in Region 3, including four prehistoric period sites, three historic period sites, and one site whose age is not specified (Table 3.9-7). None of these has been determined to be eligible for or is listed on the NRHP, and one historic period farmstead is described as not NRHP eligible. General artifact scatters are the only type of prehistoric archaeological site that have been documented in Region 3, while farmsteads are the only type of historic archaeological site type documented for the region. The Applicant Proposed Route and HVDC alternative routes cross several nineteenth-century cattle trails, military roads, and early railroad lines, but no archaeological sites or standing structures have been recorded as specifically associated with these routes in the region.

Table 3.9-7:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 3

	APR	AR 3-A	AR 3-B	AR 3-C	AR 3-D	AR 3-E
Archaeological Sites[1]						
Prehistoric	0	0	0	4	0	0
Historic	2	0	0	1[2]	1[2]	0
Multicomponent	0	0	0	0	0	0
Not Specified	0	0	1	0	0	0
Total Archaeological Sites	2	0	1	5	1	0
Aboveground Historic Properties[1]						
Inventoried Buildings and Structures	2[3]	0	0	0	0	0
NRHP-Listed Properties	0	0	0	2[4]	2[4]	0
Total Aboveground Properties	2	0	0	2	2	0
Historic Routes, Trails, and Roads[1]	20	4	6	19	14	2

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Duplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 3-C and 3-D.
3 Includes one structure consultant-recommended as NRHP eligible.
4 Duplicate counts—the same two properties occur in conterminous sections of HVDC Alternative Routes 3-C and 3-D.
Source: Modified from Clean Line (2013, Table 3-15)

The Applicant Proposed Route and HVDC Alternative Route 3-C both intersect the historic U.S. Route 66 corridor in Creek County near the midpoint of Region 3. The Applicant Proposed Route intersects the historic U.S. Route 66 corridor approximately 5 miles northeast of Bristow. HVDC Alternative Route 3-C intersects the historic U.S. Route 66 corridor approximately 5.3 miles west-southwest of Bristow. The Applicant Proposed Route passes within approximately 0.5 mile south of a 1.8 mile segment of the 1926 Portland Concrete-paved alignment of U.S. Route 66, which is the longest privately owned section of unaltered first-generation paving in Oklahoma. This segment is recommended as eligible for the NRHP; information on OKSHPO concurrence (if any) is not available. No historic resources associated with historic U.S. Route 66 have been documented within at least 1.3 miles of HVDC Alternative 3-C (Anderson et al. 2002, Maps 22–23; OKDOT 2012).

The ROI for potential visual impacts for HVDC Alternative Routes 3-C and 3-D contains two NRHP-listed properties (Table 3.9-3), both situated in the vicinity of Oktaha, Muskogee County, Oklahoma, which is located toward the eastern end of the ROI. The listed properties are the Oktaha School and the Honey Springs Battlefield, which is also listed as a National Historic Landmark (NHL) as of 2013. Oktaha School is situated approximately 0.29 mile north of HVDC Alternative Routes 3-C and 3-D conterminous centerlines. The boundaries of Honey Springs Battlefield as defined in the nomination by which the property was listed on the NRHP in 1970 are approximately 0.10 to 3.54 miles south of the same two alternatives. The NHL nomination, which reflects an additional 40 years of historical and archaeological research on the battle as well as a more refined assessment of the current integrity of the battlefield, delineates boundaries approximately 0.41 mile to 3.44 miles south of the alternatives (Fischer and Ruth 1970; NPS 2013, 2014b; Clean Line 2013; Warde et al. 2012). Both properties are also important to the history of Native Americans in Oklahoma.

Aside from the two NRHP-listed properties, no aboveground buildings, structures, districts, sites, or objects properties have been inventoried as historic resources in the 1-mile ROI for Region 3.

3.9.5.4 Region 4

Occupied by the Osage, a Siouan-speaking people, in late prehistory and the historical period, the region is part of the Plains culture area as defined by ethnographers for Native American peoples (after roughly 1650 AD) (Bailey 2001; DeMallie 2001). The western part of Region 4 is part of the OAS's Caddoan Origins research region for Native American archaeology (OAS 2011). Region 4 is situated within OKSHPO's (2014a) historic preservation planning and management Region 3 (Northeastern Oklahoma). In Arkansas, Region 4 is part of the Ozark Plateau/Arkansas Valley geographic region (Clean Line 2013).

Geographically, Region 4 skirts the border between the Ozark Plateau physiographic province to the north and the Ouachita Mountain province to the south (Wedel and Frison 2001, Figure 1). It is characterized by undulating to hilly terrain, with some sections of the alternative alignments crossing the rugged terrain of the southern edge of the Boston Mountains. The natural vegetation is a mosaic of prairie, savanna, woodland, and forest and includes pine–oak savanna, oak–hickory forest, and oak–hickory–pine forest (Woods et al. 2004, 2005). Modern land use is varied and includes haylands, pasture, and forest. The archaeological record of Region 4 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small villages of round or elongate at-grade, earthfast sapling-frame dwellings built by Native American horticulturalists in late prehistory to the remains of homesteads and other structures of nineteenth- and twentieth-century non-Indian settlers (Clean Line 2013). The archaeology of the Region 4 in eastern Oklahoma and western Arkansas reflects the transitional character of the region, with trends characteristic of the Eastern Woodlands and Southeast developing in concert with trends more characteristic of the Plains region (OAS 2011; Clean Line 2013). Prehistoric Native American site types include isolated finds (artifacts), lithic scatters, camps and villages, mounds, rock art localities, and quarries. Historic period property types include residences and farmsteads, commercial properties, small- and large-scale industrial enterprises, military facilities, transportation-related structures, cemeteries, and religious properties (AHPP 2013; Clean Line 2013). Property types associated with the Bell-Drane Cherokee Removal Route of the Trail of Tears (1838–1839) (described below) where intersected by the ROI potentially include roadbed segments; ferry crossings, landings, and fords; campsites; buildings, structures, and building sites; and gravesites (Thomason and Parker 2003, Appendix F).

Available information indicates that, in general in Region 4, prehistoric and historic archaeological sites occur most frequently "in undulating hills and at stream basins." Historical settlement was dispersed across the region, and the region was crossed by several historical transportation corridors, including a segment of the Trail of Tears National Historic Trail (Clean Line 2013).

The Trail of Tears in Region 4 is a multi-branched linear resource management corridor, rather than a single continuous historic resource or discontinuous historic district. This network of trails was used during the forced relocation of Native American peoples indigenous to the southeastern United States to Indian Territory (now Oklahoma) in the 1830s. The NPS leads a group of federal, state, local, non-governmental, and private stakeholders in the identification, preservation, interpretation, and promotion of the Trail of Tears National Historic Trail and associated properties. Greatly expanded in 2009, the Trail of Tears National Historic Trail consists of several separate branches that cross, and in one case terminate in, Arkansas. The ROI for the Project intersects the branch of the Trail of Tears now called the Bell-Drane Route between western Crawford County and south-central Johnson

County. Generally following the old Little Rock-to-Fort Gibson Road up the northern side of the Arkansas Valley as far west as Fort Smith, this trail segment is typically described as approximating the present route of U.S. Route 64. From the vicinity of Fort Smith, the Bell-Drane Route turns north and approximates State Route 59 to Evansville, in southwestern Washington County near the Arkansas-Oklahoma line. Between late July 1838 and early January 1839, three groups of Cherokee numbering from around 660 to 1,000 each followed the Bell-Drane Route through the ROI to exile in eastern Indian Territory (Horne 2006; NPS 2007, 2014c; Thomason and Parker 2003, Appendix E).

Including duplicate counts, 62 archaeological sites have been documented for the ROI in Region 4 (Table 3.9-8). This count comprises 24 occurrences of prehistoric period sites, 28 occurrences of historic period sites, and 10 multicomponent (most of which are prehistoric and historic period) sites. Prehistoric archaeological site types include general artifact scatters, open camps, and rockshelters. Historic period archaeological sites include building ruins and foundations (“structures” and “isolated structures”), farmsteads, markers, general artifact scatters, and unspecified. Three individual archaeological sites have been determined to be eligible for the NRHP, including one prehistoric period site and two multicomponent sites. Prehistoric components at the NRHP-eligible sites are described as either general artifact scatters or open camps, while the two historic period components (both at the multicomponent sites) represent farmsteads. Nine sites, three each prehistoric, historic, and multicomponent, have been determined not NRHP eligible; the remaining sites are unevaluated (Clean Line 2013). While tribal resources have not been delineated across the Project ROI, tribal consultation with DOE in September 2013 indicated the possibility that the Applicant Proposed Route in Region 4 may intersect a “burial site location and a ceremonial grounds location.”.

Table 3.9-8:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 4

	APR	AR 4-A	AR 4-B	AR 4-C	AR 4-D	AR 4-E
Archaeological Sites[1]						
Prehistoric	10	5[2]	7[2]	0	0	2
Historic	3	3[3]	18[3]	0	1[3]	3
Multicomponent	7	1	0	0	0	2
Not Specified	0	0	0	0	0	0
Total Archaeological Sites	20	9	25	0	1	7
Aboveground Historic Properties[1]						
Inventoried Buildings and Structures	5	2[4,5]	3[4,5]	0	3[5]	1
NRHP-Listed Properties	1	0	1	0	0	2
Total Aboveground Properties	6	2	4	0	3	3
Historic Routes, Trails, and Roads[1,6]	8	7	8	1	1	1

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Includes two duplicate counts—the same two sites occur in conterminous sections of HVDC Alternative Routes 4-A and 4-B.
3 Includes one triplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 4-A, 4-B, and 4-D.
4 Includes one duplicate count—the same historic property occurs in conterminous sections of HVDC Alternative Routes 4-A and 4-B.
5 Includes one triplicate count—the same historic property occurs in conterminous sections of HVDC Alternative Routes 4-A, 4-B, and 4-D.
6 Most historic routes enumerated in this table are located in Oklahoma. Considerably less readily accessible public information is available for the Arkansas portion of Region 4 than for Oklahoma.
Source: Modified from Clean Line (2013, Table 3-19)

The Applicant Proposed Route and HVDC alternative routes intersect the Bell-Drane Route of the Trail of Tears in the east-central section of Region 4. Intersections occur at roughly 11 locations between the vicinity of State Route 59 north of Fort Smith, Arkansas, on the west, and approximately 6.5 miles west of Clarksville, Arkansas, on the east. Five intersections occur close to the north-south-aligned State Route 59 at the western end of this area. No historic properties associated with the Trail of Tears have been inventoried in the vicinity of any of these intersections. In addition to the Trail of Tears, the ROI is reported to cross several other historic transportation corridors in different places along the Applicant Proposed Route and HVDC alternative routes, but no historic properties are known to be associated with any of these intersections (Clean Line 2013).

Including duplicate counts, 18 historic buildings and structures have been inventoried at various locations along the Applicant Proposed Route and HVDC alternative routes (Table 3.9-8). The majority of the buildings and structures are unevaluated for NRHP eligibility. One has been determined ineligible, and two have been determined NRHP eligible. Within the 1-mile ROI for aboveground historic properties for the Applicant Proposed Route and HVDC alternative routes, four buildings and structures have been listed on the NRHP (Table 3.9-3). All are located in the Arkansas portion of Region 4 and include the Mulberry River Bridge, 0.28 mile from the Applicant Proposed Route in Crawford County; Lucian Wood Road Segment of the Butterfield Overland Mail Route, 0.08 mile from HVDC Alternative Route 4-B, also in Crawford County; and Lutherville School and the Munger House, 0.09 and 0.05 mile from HVDC Route Alternative 4-E in Johnson County (Clean Line 2013; NPS 2014b).

3.9.5.5 Region 5

Occupied by the Quapaw, a Siouan-speaking people, in late prehistory and the historical period, the region lies at the eastern edge of the Plains culture area as defined by ethnographers for Native American peoples (after roughly 1650 AD) (DeMallie 2001). Though the Quapaw are regarded as a Plains people on the basis of language and other cultural traits, their settlement and subsistence practices closely resembled those of the Eastern Woodlands peoples to the east more than those of the Plains peoples to the west, due to the predominantly forested environment of their homeland (Young and Hoffman 2001). Region 5 is part of the Ozark Plateau/Arkansas Valley geographic region used for archaeological and historic resources management in Arkansas (Clean Line 2013).

Geographically, Region 5 skirts the border between the Ozark Plateau physiographic province to the north and the Ouachita Mountain province to the south. It is characterized by hilly terrain that flanks the Arkansas Valley to the south. The eastern end of this region lies just inside the Lower Mississippi Alluvial Valley, which comprises most of the eastern end of the ROI (Gremillion 2004, Figure 1; Wedel and Frison 2001, Figure 1). The natural vegetation of Region 5 consists predominantly of oak-hickory and oak-hickory-pine forests (Woods et al. 2004). Modern land use includes forested areas, open lands for pasture or cultivated crops, and rural residential development. The archaeological record of Region 5 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period through the small villages of round or elongate at-grade, earthfast sapling-frame dwellings built by Native American horticulturalists in late prehistory to the remains of homesteads and other structures of nineteenth- and twentieth-century non-Indian settlers (Clean Line 2013). Prehistoric Native American site types include isolated finds, lithic scatters, camps and villages, rock art localities, and quarries. Historic period property types include residences and farmsteads, commercial, small- and large-scale industrial, military, transportation, cemeteries, and religious (AHPP 2013; Clean Line 2013).

Available information indicates that, in general, prehistoric and historic archaeological sites occur most frequently along the region's principal drainages and their major tributaries. Historical settlement was dispersed across the region; initial background research identified no well-defined, named historic transportation corridors (Clean Line 2013).

Twenty-six previously recorded cultural resources occur within the Arkansas Converter Station Alternative and AC Interconnect Siting Area (Clean Line 2013), a 25,500-acre area. These include 23 previously recorded archaeological sites (17 prehistoric sites, 4 historic sites, and 2 multicomponent sites). The prehistoric site types consist of general artifacts scatters, isolated artifacts, and open camps. The historic site types consist primarily of farmsteads. The multicomponent sites are farmsteads and prehistoric lithic scatters. Of the 23 archaeological sites, 2 are recommended eligible and 21 received no previous recommendation regarding eligibility for inclusion on the NRHP. This area includes no linear resources, no NRHP-eligible properties, and three historic historic-age buildings or structures that have not received a previous recommendation regarding eligibility for inclusion on the NRHP. Information about historic and cultural resources in the HVDC transmission facilities in Region 5 is presented below.

Including duplicate counts, 73 archaeological sites have been documented for the ROI in Region 5, including 41 occurrences of prehistoric period sites, 27 occurrences of historic period sites, and 3 occurrences of a single multicomponent site (Table 3.9-9). Prehistoric archaeological site types include general artifact scatters, open camps, and rockshelters. Historic period archaeological sites include building ruins and foundations ("structures" and "isolated structures"), farmsteads, isolated finds, and general artifact scatters. In addition, five localities are recorded as historic archaeological sites that might equally have been inventoried as historic architectural properties; these include four historic cemeteries and a Cold War-era missile complex. Three separate multicomponent archaeological sites, all of which are general artifact scatters containing both prehistoric and historic materials, are also documented for the Applicant Proposed Route and HVDC alternative routes in Region 5. Of the 50 individual archaeological sites included in the ROI for the Applicant Proposed Alternative and the HVDC alternative routes, two sites, a prehistoric period rockshelter and a historic period structure, have been determined to be eligible for the NRHP, while three prehistoric sites and eight historic sites are not eligible for the NRHP. The remaining 36 individual sites are unevaluated for NHRP eligibility (Clean Line 2013).

Table 3.9-9:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 5

	APR	AR 5-A	AR 5-B	AR 5-C	AR 5-D	AR 5-E	AR 5-F
Archaeological Sites[1]							
Prehistoric	7	0	13[2]	2	3	8[2]	8[2]
Historic	3	0	12[3,4]	1	6	3[3,4]	2[4]
Multicomponent	2	0	1[5]	0	0	1[5]	1[5]
Not Specified	0	0	0	0	0	0	0
Total Archaeological Sites	12	0	26	3	9	12	11
Aboveground Historic Properties[1]							
Inventoried Buildings and Structures	16[6]	0	23[6,7,8]	3	3	20[6,7,8]	17[6,7]
NRHP-Listed Properties	2[9]	0	2[10]	1[9]	0	1[10]	1[10]
Total Aboveground Properties	18	0	25	4	3	21	18
Historic Routes, Trails, and Roads[1,11]	0	0	0	0	0	0	0

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Includes eight triplicate counts—the same eight sites occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
3 Includes one duplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 5-B and 5-E.
4 Includes two triplicate counts—the same two sites occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
5 Includes one triplicate count—the same site occurs in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
6 Includes two quadruplicate counts—the same two historic properties occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F and in the conterminous 1-mile ROI of Applicant Proposed Route Links 5 and 6.
7 Includes 15 triplicate counts—the same 15 historic properties occur in conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
8 Includes three duplicate counts—the same three historic properties occur in conterminous sections of HVDC Alternative Routes 5-B and 5-E.
9 Includes one duplicate count—the same NRHP-listed property occurs in the conterminous ROI of the Applicant Proposed Route and Alternative Route 5-C.
10 Includes one triplicate count—the same NRHP-listed property occurs in the conterminous sections of HVDC Alternative Routes 5-B, 5-E, and 5-F.
11 No readily accessible public information concerning historic routes, trails, and roads is available for Region 5.
Source: Clean Line (2013, Table 3-24)

Including duplicate counts, a total of 89 buildings and structures are included in the Region 5 ROI. Aside from the four historic cemeteries and the Cold War missile complex that that have been inventoried as archaeological sites (see above), approximately 47 individual historic buildings and structures have been inventoried at various locations along the Applicant Proposed Route and HVDC alternative routes. The majority of the buildings and structures are unevaluated for NRHP eligibility. At least three, however, been determined NRHP ineligible. Four buildings in the 1-mile ROI for the Applicant Proposed Route and HVDC alternative routes are listed on the NRHP (Table 3.9-3). All are located in Arkansas. The listed properties are the William Henry Watson Homestead, White County, 0.34 mile from the Applicant Proposed Route; the Charlie Hall House, Faulkner County, 0.05 mile from HVDC Alternative Route 5-B; the New Mt. Pisgah School, White County, 0.29 mile from overlapping HVDC Alternative Routes 5-B, 5-E, and 5-F; and the Wesley Marsh House, a minimum of 0.34 mile from the Applicant Proposed Route and HVDC Alternative Route 5-C (Clean Line 2013; NPS 2014b).

3.9.5.6 Region 6

Occupied in late prehistory and the protohistoric period by Tunica and subsequently the Quapaw, the region lies at the southwestern edge of the northeastern Woodlands culture area as defined by ethnographers for Native American peoples living in the region around the time of the arrival of European explorers and colonists (Brain et al. 2004; Callender 1978; Dye 2007; Trigger 1978). Region 6 is part of the Mississippi Alluvial Valley geographic region used for archaeological and historic resources management in Arkansas (Clean Line 2013).

Geographically, Region 6 is situated entirely within the Lower Mississippi Alluvial Valley physiographic province (Gremillion 2004, Figure 1). It is characterized by broad, flat to nearly flat meander belts associated with the modern Mississippi River and several of its important tributaries (the Cache and White rivers) with intervening older alluvial and wind-transported sediments comprising valley train materials deposited during the Pleistocene epoch, the most recent episode of worldwide continental glaciation. Region 6 also crosses Crowley's Ridge in the east-central portion of Region 6, a string of low hills covered by up to several tens of feet of fine wind-blown silt (loess). The natural vegetation of Region 6 is a complex mosaic locally shaped by the alluvial, Pleistocene, and relict landforms present. In better-drained alluvial bottomlands, oak-dominated hardwood forests predominate, while on active natural levees and wooded portions of backswamps and abandoned channels, there is less oak, and trees such as sugarberry, elm, ash, pecan, cottonwood, and sycamore are common. In less frequently flooded areas, such as Crowley's Ridge and portions of the Pleistocene valley trains, forests and woodlands of post oak-blackjack oak, southern red oak-white oak, beech-maple, and post oak-loblolly pine occur. Except for Crowley's Ridge, where substantial tracts of hardwood forest remain, most of the formerly forested lands of Region 6 have been cleared, and modern land use is principally agricultural. Crops such as rice, corn, and soybeans dominate (Woods et al. 2004).

The archaeological record of Region 6 spans over 12,000 years. For the period before European intrusion into the region, the archaeological record encompasses sites of the early Native American, herd-oriented hunters and gatherers of the Paleoindian period, as well as their successors, the efficient hunter-gatherer-fishers of the mast forests and southern rivers of the Archaic period. The archaeological record continues through the camps and villages of the pottery-making horticulturalists of the Woodland period to the farmsteads, hamlets, villages, and earthworks of the late prehistoric Mississippian period. The Mississippi Valley also contains traces of several hundred years of Euroamerican exploration, settlement, warfare, and development, beginning in the mid-seventeenth century. Prehistoric Native American site types include isolated finds, lithic scatters, camps, farmsteads, hamlets, and villages, earth burial and temple mounds, and cemeteries. Historic period property types include residences, farmsteads, and plantations; commercial and small-scale industrial properties; and military, transportation, cemeteries, and religious buildings, structures, and sites (AHPP 2013; Clean Line 2013).

Available information indicates that area "geomorphology and topography greatly influenced settlement patterns in this region. In this relatively flat landscape, minor differences in elevation greatly affect the character of the local floral and faunal communities…. [Sites] at high natural levee ridges between stream meander belts and higher interfluvial 'islands' on Pleistocene terraces" were apparently favored locations for habitation over thousands of years. Historical settlement was dispersed across the region; initial background research identified no well-defined, named historic transportation corridors (Clean Line 2013).

Fourteen archaeological sites (the count involves no duplicates) have been documented for the ROI in Region 6, including 13 prehistoric period sites and one historic period site (Table 3.9-10). Sites are recorded for the Applicant Proposed Route and each alternative except HVDC Alternative Route 6-D, for which no archaeological sites have been identified to date. Prehistoric archaeological site types include general artifact scatters, isolated finds, and villages. The historic period site is described as an "isolated enclosure." None of the 14 inventoried sites has been evaluated for NRHP eligibility. Very few historic buildings and structures have been recorded in the ROI for potential visual impacts for the Applicant Proposed Route and HVDC alternative routes, and none has been assessed for NRHP eligibility. Of the four historic buildings and structures inventoried for the ROI in Region 6, one is located along the Applicant Proposed Route, one is found along HVDC Alternative Route 6-A, and two occur along HVDC Alternative Route 6-B. No NRHP-listed properties are recorded for Region 6 (Clean Line 2013).

Table 3.9-10:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 6

	APR	AR 6-A	AR 6-B	AR 6-C	AR 6-D
Archaeological Sites[1]					
Prehistoric	4	1	3	5	0
Historic	1	0	0	0	0
Multicomponent	0	0	0	0	0
Not Specified	0	0	0	0	0
Total Archaeological Sites	5	1	3	5	0
Aboveground Historic Properties[1]					
Inventoried Buildings and Structures	1	1	2	0	0
NRHP-Listed Properties	0	0	0	0	0
Total Aboveground Properties	1	1	2	0	0
Historic Routes, Trails, and Roads[1,2]	0	0	0	0	0

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor. There are no duplicate, triplicate, or quadruplicate resource counts in Region 6.
2 No readily accessible public information concerning historic routes, trails, and roads is available for Region 6.
Source: Clean Line (2013, Table 3-31)

3.9.5.7 Region 7

Occupied in late prehistory and the protohistoric period by the Tunica and subsequently the Quapaw, the region lies at the southwestern edge of the northeastern Woodlands culture area for Native American peoples living in the region around the time of the arrival of European explorers and colonists (Brain et al. 2004; Callender 1978; Dye 2007; Trigger 1978). Region 7 is part of the Mississippi Alluvial Valley geographic region used for archaeological and historic resources management in Arkansas (Clean Line 2013). In Tennessee, Region 7 is located in Development District 1 (Memphis Area), one of nine multicounty planning regions mandated by the state legislature, whose functions have grown to encompass historic preservation outreach and planning (Tennessee Historical Commission 2013).

Geographically, Region 7 is mostly situated within the Lower Mississippi Alluvial Valley physiographic province, but the last 9 miles of the Applicant Proposed Route are located in the Southeastern Coastal Plain (locally called the West Tennessee Plateau Slope) province (Gremillion 2004, Figure 1). Overall, Region 7 is characterized by broad, flat to nearly flat meander belts associated with the modern Mississippi River with intervening Pleistocene alluvial and wind-transported sediments comprising valley train deposits. The eastern end of the ROI is characterized by a

150-foot bluff marking the edge of the Mississippi floodplain, east of which are located rolling, irregular plains; a thick blanket of Pleistocene-age wind-blown sediment (loess) caps the landscape at the eastern end of Region 7. In the Mississippi Valley, the natural vegetation of Region 7 is a complex mosaic locally shaped by the alluvial, Pleistocene, and relict landforms present. Broadly speaking, the natural vegetation of the Mississippi meander belts is the Southern floodplain forest (oak, tupelo, bald cypress). Swampy woodlands are often occupied by cypress-gum woodlands, while the uplands of the eastern end of Region 7 are dominated by oak-hickory forests, with abundant beech and sugar maple in some areas. Land use west of the Mississippi River consists chiefly of cultivated crops, while east of the river land use is a mix of agricultural land, hardwood forests, and residential and commercial development (Griffith et al. 1998; Woods et al. 2004).

The archaeological record of Region 7 spans over 12,000 years, extending from the sites of early Native American hunter-gatherers of the Paleoindian period to the farmsteads, hamlets, villages, and earthworks of the late prehistoric Mississippian period. The Mississippi Valley also contains traces of several hundred years of Euroamerican exploration, settlement, warfare, and development, beginning in the mid-seventeenth century. Prehistoric Native American site types include isolated finds, lithic scatters, camps, farmsteads, hamlets, and villages, earth burial and temple mounds, and cemeteries. Historic period property types include residences, farmsteads, and plantations; commercial and small-scale industrial properties, and military, transportation, cemeteries, and religious buildings, structures, and sites (AHPP 2013; Clean Line 2013).

Available information indicates that archaeological sites and historic buildings and structures occur mainly along major streams and focus toward the Mississippi. In the Mississippi meander belts “geomorphology and topography greatly influenced settlement patterns in this region. In this relatively flat landscape, minor differences in elevation greatly affect the character of the local floral and faunal communities…. [Sites] at high natural levee ridges between stream meander belts and higher interfluvial “islands” on Pleistocene terraces” were apparently favored locations for habitation over thousands of years. Historical settlement was dispersed across the region, except in the vicinity of Millington, Tennessee, and a few other small population centers (Clean Line 2013). Although the Mississippi River, which the ROI crosses near Island Number 35, has had vast historical significance for water transport since the mid-eighteenth century, the ROI intersects no well-defined, named historic land routes adjacent to the river. Bell’s Route of Trail of the Tears National Historic Trail crosses east-central Shelby County, Tennessee, several miles south of the ROI. Historians are highly confident that Bell’s Detachment of approximately 660 exiled Cherokee travelled through the area on November 22, 1838 via Stage Road (Tennessee State Route 15) (Nance 2001; NPS 2007, Map 5; Thomason and Parker 2003, Appendix E). At its closest, Stage Road passes approximately 6.8 miles south of any portion of the Applicant Proposed Route or HVDC Route Alternatives.

No historic or cultural resources have been identified within the Tennessee Converter Station Siting Area (Clean Line 2013). Information about historic and cultural resources in the HVDC transmission facilities in Region 7 is presented below.

Including duplicate counts, 37 archaeological sites have been documented for the 1,000-foot corridor ROI in Region 7, including an estimated 20 occurrences of prehistoric period sites (17 individual sites), 9 historic period sites (no duplicates), 7 multicomponent sites (no duplicates), and 1 site with no period attributed to it (Table 3.9-11). Thirty individual archaeological sites, including all 17 unique prehistoric sites, 6 each of the historic and multicomponent sites, and the unattributed site have not been evaluated for NRHP eligibility. Four sites, including three historic period sites and one multicomponent site, have been determined not eligible for the NRHP (Clean Line 2013).

Table 3.9-11:
Previously Inventoried Historic and Cultural Resources in the ROI for the Applicant Proposed Route and HVDC Alternative Routes in Region 7

	APR	AR 7-A	AR 7-B	AR 7-C	AR 7-D
Archaeological Sites[1]					
Prehistoric	8[2]	2	2[2]	6[2]	2
Historic	2	4	0	3	0
Multicomponent	3	1	0	3	0
Not Specified	0	0	0	1	0
Total Archaeological Sites	13	7	2	13	2
Aboveground Historic Properties[1]					
Inventoried Buildings and Structures	40[3]	2	0	39[3]	0
NRHP-Listed Properties	0	2[4]	0	0	0
Total Aboveground Properties	40	4	0	39	0
Historic Routes, Trails, and Roads[1,5]	0	0	0	0	0

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Includes one quadruplicate count—the same site is counted twice for the Applicant Proposed Route and also once each in HVDC Alternative Routes 7-B and 7-C, because they are located at a junction for two links of the Applicant Proposed Route and in the adjoining conterminous sections of the alternative routes.
3 Includes one duplicate count—the same historic property occurs in the 1-mile ROI of corresponding link of the Applicant Proposed Route (Link 5) and the overlapping ROI for HVDC Alternative Route 7-C.
4 Includes the Nodena Site NHL, a belowground historic property, which is believed to be located outside the 1,000-foot ROI but within the 1-mile ROI for HVDC Alternative Route 7-A.
5 No readily accessible public information concerning historic routes, trails, and roads is available for Region 6.
Source: Modified from Clean Line (2013, Table 3-34)

In addition to the archaeological sites documented as occurring within the 1,000-foot corridor ROI for the Applicant Proposed Route and HVDC alternative routes, one important prehistoric archaeological site is situated within the 1-mile ROI for historic resources. This is the Nodena Site in Mississippi County, Arkansas. The site is both listed on the NRHP and as a National Historic Landmark (Table 3.9-3). HVDC Alternative Route 7-A crosses more than 0.1 mile to the east of the Nodena Site NHL, which is situated approximately 5 miles east-northeast of Wilson, Arkansas. The exact location of the site is not publicly available, because the property has a restricted address to prevent vandalism. The NRHP/NHL property covers approximately 305 acres and apparently includes several separately designated sites, including the Upper Nodena Site (3MS4) and the Middle Nodena Site (3MS3) (AHPP 2014; Mainfort et al. 2007; NPS 2014b). (Because it is outside the 1,000-foot corridor ROI, the Nodena Site NHL is not included in the archaeological site count of Table 3.9-11.)

Prehistoric period archaeological site types in Region 7 include general artifact scatters, open camps, and village sites. The Mississippian period Nodena Site (ca. 1400 to 1650 AD) is a categorized as a village site. Historic period archaeological site types include farmsteads and general artifact scatters. Multicomponent site types include general artifact scatters and open camps in association with farmsteads (Clean Line 2013).

Including one duplicate count, but excluding the Nodena Site NHL, 82 buildings and structures have been inventoried to date within the 1-mile ROI for the Applicant Proposed Route and HVDC Alternative Routes 7-A and 7-C

(Table 3.9-11). Thirty-nine (plus one duplicate) of the inventoried properties occur along the Applicant Proposed Route, and all are situated in the more densely developed Tennessee portion of the alignment. Thirty-eight (plus one duplicate) of the inventoried properties occur along HVDC Alternative Route 7-C, also in Tennessee. None of these properties has been evaluated for eligibility to the NRHP. The remaining two properties occur near HVDC Alternative Route 7-A, probably in Arkansas. One has been recommended as NRHP eligible (Clean Line 2013).

Aside from the Nodena Site NHL, one other NRHP-listed property occurs within the ROI for Region 7. This is the Highway A-7 Bridges Historic District, which is crossed by HVDC Alternative Route 7-A in the vicinity of Marked Tree, Poinsett County, Arkansas (Table 3.9-3).

3.9.5.8 Connected Actions

3.9.5.8.1 Wind Energy Generation

Wind energy generation would likely occur within WDZs. The twelve WDZs contain a total of 155 prehistoric, historic, multicomponent, and indeterminate previously recorded archaeological sites (Table 3.9-12). The WDZs do not overlap, and frequencies of inventoried historic and archaeological resources given in Table 3.9-12 do not contain duplications. There are also 77 inventoried historic buildings and structures and 8 identified intersections of historic routes, trails, and roads (Table 3.9-12). Six historic buildings and structures and one archaeological site listed on the NRHP also occur in the WDZs (Table 3.9-13). Previously recorded sites within the WDZs have not been evaluated for their potential to be eligible to the NRHP.

As noted in the discussion of the Region 1 AC Collection System Route, at least one of the NRHP-listed properties, the Tracey Wood-Frame Grain Elevator, appears to have suffered severe loss of integrity and may no longer be eligible for the register. It is unknown whether any other NRHP properties have experienced similar losses.

Table 3.9-12:
Previously Inventoried Historic and Cultural Resources by Wind Development Zone

	WDZ											
	A	B	C	D	E	F	G	H	I	J	K	L
Archaeological Sites												
Prehistoric	4	3	0	4	1	4	22	9	9	42	0	10
Historic	2	0	0	6	1	0	2	1	3	7	4	2
Multicomponent	0	0	0	1	0	1	0	0	1	2	1	0
Not Specified	0	0	0	0	0	1	2	5	1	0	0	4
Total Archaeological Sites	6	3	0	11	2	6	26	15	14	51	5	16
Aboveground Historic Properties												
Inventoried Buildings and Structures	25	0	0	0	0	36	0	0	13	0	3	0
NRHP-Listed Properties	1	0	0	0	0	1	0	2	2	0	0	1[1]
Total Aboveground Properties	26	0	0	0	0	37	0	2	15	0	3	1
Historic Routes, Trails, and Roads	1	0	0	0	0	1	1	1	2	1	1	0

1 The NRHP-listed property in WDZ-L is the Buried City Site (41OC1), a belowground historic property (prehistoric archaeological site). It is unknown whether the Buried City Site or any of its separately inventoried components are included in the prehistoric site count for WDZ-L.

Source: Clean Line (2014, pp 201–204)

Table 3.9-13:
NRHP-Listed Properties in the Wind Development Zones

WDZ	Property Name (Alternate Name)	NRIS No.	Location
A	Plainview Hardware Company Building	90000904	Perryton, Ochiltree County, Texas
F	Penick House (Raymond Choate House)	84003436	Texhoma, Texas County, Oklahoma
H	Eva Wood-Frame Grain Elevator (Wright Grain & Milling Co. Elevator)	83002132	Eva, Texas County, Oklahoma
H	Tracey [or Tracy] Wood-Frame Grain Elevator (Genco Grain Co. Elevator)	83002137	Muncy (Tracey), Texas County, Oklahoma
I	Adams Wood-Frame Grain Elevator (Old Tex-Co Elevator)	83002129	Adams, Texas County, Oklahoma
I	Hooker Wood-Frame Grain Elevator (Wheat Pool Elevator Company)	83002133	Hooker, Texas County, Oklahoma
L	Buried City Site (41OC1)	84001923	Perryton vicinity, Ochiltree County, Texas

NRIS—National Register Information System.
Note: Examination of aerial imagery available from Google Earth indicates that the Eva and Tracey wood-frame grain elevators are no longer extant. Field survey would be required to verify their disappearance.
Source: NPS (2014b)

3.9.5.8.1.1 WDZ-A

WDZ-A contains a total of six previously recorded archaeological sites (Table 3.9-12). These include four prehistoric-period sites representing two site types (artifact scatter and camp site). It also contains two historic period sites including an artifact scatter and a cemetery. These sites have not been evaluated for their potential to be eligible to the NRHP. Also previously recorded within WDZ-A are 25 historic buildings/structures and 1 historic transportation route. Of these, only the Plainview Hardware Company Building, Perryton, Texas, is NRHP-listed (Table 3.9-13), while 25 have not been evaluated for their potential to be eligible to the NRHP.

3.9.5.8.1.2 WDZ-B

The three archaeological sites recorded within WDZ-B all date to the prehistoric time period (Table 3.9-12). These include a prehistoric artifact scatter and cairn sites. One of these sites was determined not eligible for the NRHP, while the remaining two sites have not been evaluated for their potential to be eligible to the NRHP. No historic period buildings and structures or mapped historic transportation routes have been previously recorded within WDZ-B.

3.9.5.8.1.3 WDZ-C

There are no previously recorded archaeological sites within WDZ-C (Table 3.9-12). There are also no previously recorded historic period buildings, structures or mapped historic transportation routes recorded within WDZ-C.

3.9.5.8.1.4 WDZ-D

WDZ-D contains 11 archaeological sites including 4 prehistoric, 6 historic and 1 multicomponent (Table 3.9-12). The range of site types includes prehistoric artifact scatter, camp site, historic artifact scatter, farmstead, cemetery, and abandoned railroad grade. Two of these sites have been determined to be eligible to the NRHP, six have not been evaluated for their potential to be eligible to the NRHP, and three are not eligible to the NRHP. No historic period buildings and structures or mapped historic transportation routes have been recorded within WDZ-D.

3.9.5.8.1.5 WDZ-E

Two archaeological sites have been recorded within WDZ-E (Table 3.9-12). The one prehistoric artifact scatter and the one historic artifact scatter have not been evaluated for their potential to be eligible to the NRHP. No historic period buildings and structures or mapped historic transportation routes have been recorded within WDZ-E.

3.9.5.8.1.6 WDZ-F

Previously recorded archaeological sites within WDZ-F include four prehistoric sites, one multicomponent site, and one temporally unspecified site (Table 3.9-12). The range of site types represented includes prehistoric camp, historic farmstead, and unspecified sites. Five of these sites have not been evaluated for their potential to be eligible to the NRHP while one site was determined not eligible for the NRHP. Within WDZ-F, 37 buildings/structures and 1 historic transportation route have been previously recorded. Of these, only the Penick House, Texhoma, Oklahoma, is listed in the NRHP (Table 3.9-13), while 37 have not been evaluated for their potential to be eligible to the NRHP.

3.9.5.8.1.7 WDZ-G

Records reviewed indicated 26 archaeological sites within WDZ-G (Table 3.9-12). Of these, 22 are prehistoric, 2 historic and 2 are temporally unspecified. Site types represented include prehistoric artifact scatters, camps, historic farmsteads, and unspecified site types. Four of these sites were determined not eligible to the NRHP while 22 sites have not been evaluated for their potential to be eligible to the NRHP. One historic transportation route was previously recorded within WDZ-G, though this site has not been evaluated for its potential to be NRHP-eligible.

3.9.5.8.1.8 WDZ-H

Within WDZ-H, 15 archaeological sites have been previously recorded, including 9 prehistoric sites, 1 historic site, and 5 temporally unspecified sites (Table 3.9-12). Site types represented include prehistoric artifact scatter, historic farmstead, and unspecified site types. Four of the sites have been evaluated as not eligible to the NRHP while 11 of the sites have not been evaluated for their potential to be NRHP-eligible. WDZ-H contains two NRHP-listed properties in Oklahoma, the Eva Wood-Frame Grain Elevator, Eva, and the Tracey Wood-Frame Grain Elevator, Muncy (Table 3.9-13). One historic transportation route is recorded from documentary sources, but additional property has been recorded but not evaluated for its potential to be eligible to the NRHP.

3.9.5.8.1.9 WDZ-I

There are 14 previously recorded archaeological sites within WDZ-I (Table 3.9-12), including 9 prehistoric sites, 3 historic sites, 1 multicomponent site, and 1 unspecified site. Site types represented include prehistoric artifact scatter, camp, historic artifact scatter, and cemetery. Three of these sites have been determined to be not eligible for the NRHP while 11 have not been evaluated for their potential to be NRHP-eligible. WDZ-I contains the Adams Wood-Frame Grain Elevator, Adams, Oklahoma, and Hooker Wood-Frame Grain Elevator, Hooker, Oklahoma, both listed in the NRHP (Table 3.9-13). In addition, 13 buildings/structures and 2 historic transportation routes have been previously recorded but not evaluated for their potential to be eligible to the NRHP.

3.9.5.8.1.10 WDZ-J

Within WDZ-J, 51 archaeological sites have been recorded previously (Table 3.9-13). Of these, 42 sites are prehistoric, 7 are historic, and 2 are multicomponent. Represented site types include prehistoric artifact scatter, camp, historic artifact scatter, farmstead sites, and an isolated prehistoric burial. Thirty-six of these sites have not been evaluated for their potential to be eligible to the NRHP while 14 sites have been determined to be not eligible to the NRHP. One previously recorded historic transportation route has not been evaluated for its potential to be eligible to the NRHP.

3.9.5.8.1.11 WDZ-K

Five archaeological sites have been previously recorded within WDZ-K (Table 3.9-12). These include four historic period sites and one multicomponent site. Site types represented include prehistoric artifact scatter, camp, historic artifact scatter, and cemetery sites. The potential for these sites to be eligible to the NRHP is unknown. Three buildings/structures and one historic transportation route were previously recorded within WDZ-K. Three of these have been determined to be NRHP-eligible, and one has not been evaluated for its potential to be eligible to the NRHP.

3.9.5.8.1.12 WDZ-L

Within WDZ-L, 16 archaeological sites have been previously recorded including 10 prehistoric, 2 historic, and 4 unspecified (Table 3.9-12). Site types represented include prehistoric camps, historic farmsteads, and unspecified site types. These sites have not been evaluated for their potential to be eligible to the NRHP. One prehistoric archaeological site is listed on the NRHP, the Buried City Site in Ochiltree County, Texas (Table 3.9-13). It is unknown whether the site is included in the prehistoric counts provided in Clean Line (2014), because site names are not available in the public record provided in that document. WDZ-L does not contain any previously recorded buildings/structures or historic transportation routes.

3.9.5.8.1 Optima Substation

The future Optima Substation would be on a 160-acre site located just east of the Oklahoma Converter Station Siting Area and partially within the AC Interconnection Siting Area where no historic or cultural resources have been identified.

3.9.5.8.2 TVA Upgrades

As described above under Section 3.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.9.6 Impacts to Historical and Cultural Resources

3.9.6.1 Methodology

The analysis of potential effects to historic and cultural resources uses the same ROI described in Section 3.9.3 for archaeological sites, aboveground historic properties, and historic routes. Many other resources evaluated in this EIS evaluate 200-foot representative ROWs for direct impacts, but this section uses a broader area because the APE (which DOE intends to define in a PA) may vary from the typical 200-foot-wide final ROW for the Project transmission lines (Clean Line 2013). Also, for consistency with the HVDC transmission lines, potential effects to historic and cultural resources related to AC collection system routes are evaluated across a 1,000-foot corridor instead of the larger 2-mile ROI.

The assessment of potential impacts to historic and cultural resources entailed a qualitative review of available information on these resources (following from the information described in Sections 3.9.4 and 3.9.5, above) in conjunction with consideration of potential effects of various Project activities (see Appendix F) on different types of historic and cultural resources. The strategy for assessing potential impacts from the Project resulted from the conceptual, preliminary, or non-Project-specific nature of much of the available information. Quantitative information presented below is therefore preliminary and may be refined as Project-specific cultural resources surveys are undertaken prior to construction. In particular, density calculations presented in impact tables are based on available records and may substantially underrepresent the actual resource density. As described in Section 3.9.2, field surveys will be undertaken prior to construction. The results of the surveys will provide specific information as to the presence or absence of cultural resources that may qualify as historic properties.

One proxy indicator of *potential* project interactions, impacts, or effects on historic and cultural resources is provided by considering the land cover of areas within which the Project would be constructed. Land cover is discussed and analyzed in detail in Section 3.10 using data extracted by GIS techniques from the 2006 release of the National Land Cover Database (NLCD) (GIS Data Source: Jin et al. 2013). As a proxy for assessment of *potential* Project effects, the 14 land cover classes observed in a 200-foot representative ROW (consistent with results presented in Section 3.10) were placed into four groups, representing different possible constellations of Project effects (Table 3.9-14). Land cover Group A primarily is composed of terrain that is being actively manipulated, either through crop cultivation or development. Land cover Group B is composed of terrain that is predominantly covered by perennial grasses and herbaceous vegetation and so is relatively open. Land cover Group C comprises woodlands and forests and is relatively closed. Land cover Group W is the residual group of open water, which generally comprises a small percentage of the Project acreage.

Table 3.9-14:
Land Cover Groups and Potential Project Effects on Historic and Cultural Resources

Group	Constituent Land Cover Classification	General Characteristics	Potential Project Effects On Historic and Cultural Resources
A	Barren Land Cultivated Crops Developed—Low Intensity Developed—Medium Intensity Developed—Open Space	Typically artificially landscaped or manipulated terrain; generally open and covered in relatively low, often discontinuous vegetation; often contains existing roads or field drives.	<u>Ground Disturbance</u>: Large areas of extant cleared land and availability of roads limit need for extensive new construction to provide access to and work spaces around towers and other permanent facilities. <u>Visual Exposure</u>: Potential for distant views of permanent Project elements because of limited extent of tall vegetative screening.
B	Emergent Herbaceous Wetlands Grassland/Herbaceous Pasture/Hay Shrub/Scrub	Generally open terrain covered by grasslands, shrubs, and discontinuous patches of low trees; existing road access is variable.	<u>Ground Disturbance</u>: Large areas of open land tends to limit need for vegetation clearing and thus amount of ground disturbance outside towers, other permanent facilities, and their associated work spaces. However, limited availability of existing roads in some areas may result in need for construction of temporary or permanent roads. <u>Visual Exposure</u>: Potential for distant views of permanent Project elements because of limited extent of tall vegetative screening.
C	Deciduous Forest Evergreen Forest Mixed Forest Woody Wetlands	Generally closed terrain covered by woodland; access by existing roads tends to be limited.	<u>Ground Disturbance</u>: Probable need for extensive vegetation clearance, possibly resulting in ground disturbances, at towers and other facilities, in new transmission line ROWs between towers and in construction work areas. Access road construction may be necessary. <u>Visual Exposure</u>: Distant views of permanent Project elements tend to be limited in extent because of extensive of tall vegetative screening.
W	Open Water	Water bodies such as rivers, streams, ponds, and lakes.	Minor land cover type; not analyzed.

Source: GIS Data Source: Jin et al. (2013)

Pursuant to the PA, in coordination with consulting parties, more detailed assessments of potential Project impacts to historic and cultural resources will be made prior to construction. The Applicant would also develop and implement plans to manage identification, assessment, and treatment of these resources. DOE intends to define the plans and related activities in the PA. These plans would set forth the process that the Applicant would use to identify, evaluate, and treat unanticipated historic properties and cultural resources discovered during construction and operations and maintenance phases of the Project. The evaluation of potential impacts in the following sections assumes implementation of these plans.

3.9.6.1.1 Impacts Common to All Project Components

This section describes potential Project impacts that could affect historic and cultural resources anywhere within the ROI.

The characteristics of specific historic and cultural resources fundamentally affect their susceptibility to different types of potential Project impacts. The discussion that follows focuses primarily on potential direct, physical impacts and on potential visual impacts, because these two types of impact are the most likely to affect the kinds of historic and cultural resources that likely occur in the ROI.

Archaeological sites, consisting of patterns of objects (artifacts) on or in the ground and traces of modifications to the soil and landscape by past peoples, are primarily vulnerable to Project activities that disturb the soil. Such disturbances relocate artifacts, altering archaeologically meaningful spatial relationships among these objects and between these objects and the soil matrix within which they are located; documentation of such spatial relationships is critical to meaningful interpretation of archaeological sites. In addition, some archaeological evidence exists only as contrasting layers of soil and soil boundaries, and ground disturbances can disrupt soil boundaries, mix layers, and obliterate such evidence. Occasionally, an archaeological site's relationship to its surrounding environment is an essential characteristic that contributes fundamentally to the site's significance, and in these instances, the site may also be subject to visual impacts from a project. Typically, however, the analysis of Project impacts on archaeological resources focuses on direct ground disturbance. In the case of archaeological sites that are eligible for listing in the NRHP, efforts would be made to resolve adverse effects by means of avoidance, minimization, or mitigation as per 36 CFR 800.5(a)(1).

Installation of utility systems in rural areas, including generating facilities, transmission lines, converter stations, and other infrastructure related to the construction and/or operation of the project, would typically avoid the demolition or relocation of buildings and other existing elements of the built environment. Factors such as the cost of real estate taking and project setback requirements generally mean that historic buildings, structures, objects, and landscape features (such as identifiable cemeteries) are not directly altered physically, damaged, or demolished by electrical generation and transmission projects in rural areas. Instead, such historic and cultural resources may be impacted by the introduction of non-historical visual or, occasionally, auditory elements into their setting. The identification and analysis of potential visual impacts to historic resources overlaps with that for potential visual and aesthetic impacts (Section 3.18), but the latter is concerned with many types of resources, of which historic and cultural resources are just one category. In the case of historic architectural resources located in the vicinity of the Project that are eligible for listing in the NRHP, visual impacts might constitute an adverse effect under 36 CFR 800.5(a)(2)(v). In this instance, efforts would be made to avoid, minimize, or mitigate effects. Introduction of structures such as the proposed transmission line and associated towers into an otherwise rural or natural setting could diminish the integrity of a property's significant historic features. Assessment of effects (including visual effects) on historic properties is based in part on the evaluation of integrity.

Historic properties of particular interest to Indian Tribes are varied in their characteristics and could be subject to direct physical disturbances or to disturbances resulting from alteration of the visual surroundings, auditory field, or other characteristics of their setting. As noted in Section 3.9.4, DOE has requested information from Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking, but these resources remain to be delineated for the ROI.

The Applicant will develop plans and employ various measures during the construction and operations and maintenance phases of the Project that, if executed effectively and consistently, will help to avoid or minimize impacts to historic and cultural resources. Key Project plans related to these resources include:

- Historic Properties Treatment Plan for the early identification of historic and cultural resources within the Project footprint through appropriate surveys and for the subsequent management of identified resources within the Project footprint
- Discovery Plan that outlines the steps to be followed in the event that a historic or cultural resource is discovered during construction, maintenance, or operation

In addition, the Applicant has identified various EPMs that will help avoid or minimize impacts to historic and cultural resources. Applicable measures include:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.
- GEO-1: Clean Line will stabilize slopes exposed by its activities to minimize erosion.

3.9.6.1.2 Construction Impacts

A wide range of activities associated with the construction of the Project has the potential to result in extensive ground disturbance. From the point of view of archaeological resources, Project-related ground disturbance is the alteration of the structure, composition, and/or texture of the soil and its contents from the air-ground interface to depth in excess of that which would occur in absence of Project activities. Such impacts may occur as a result of earth moving (cutting, filling, grading, foundation preparation, sub-roadbed construction, and similar construction activities) or movements of equipment and vehicles over unprotected ground surfaces. If such ground disturbance results in physical or visual impacts to historic properties that are eligible for listing in the NRHP, such impacts could constitute an adverse effect under 36 CFR 800.5(a)(1), and, therefore, would require consultation with consulting parties to attempt to avoid, minimize, or mitigate adverse effects.

Construction could also cause temporary impacts to historic and cultural resources through the generation of dust, noise, and vibration, but such effects would be transient in nature.

Assuming that demolition of existing buildings, structures, and sites such as marked historic cemeteries would be avoided during construction, the effects of constructing the Project would be transient and limited, and could include such temporary alterations of the environment as increased noise, vibration, and dust. Because of their transient nature, such effects would not usually require mitigation in relation to historic and cultural resources.

Wooded terrain requires more ground disturbance because of the need to clear transmission line corridors and build roads, among other activities, but woodlands may also present possibilities for vegetative screening of nearby historic standing structures. Open terrain tends to reduce the need for extensive construction disturbances outside transmission towers and other ground-level facilities. At the same time, open terrain also somewhat increases the potential for adverse visual effects to historic standing structures in close proximity to the Project alignment resulting from the introduction of transmission towers and other facilities. However, with effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

As the types of tribal resources that may be present within the ROI remain to be determined, only a broad, generic description of potential impacts is possible at this time. In general, impacts to tribal resources would be similar to those that might occur to archaeological sites and historic architectural properties as described above.

3.9.6.1.3 Common Operations and Maintenance and Decommissioning Impacts

Adverse impacts to historic and cultural resources are not expected from operations and maintenance or decommissioning of the Project. Operations and maintenance activities and decommissioning would take place within areas that would have been surveyed for historic and cultural resources. DOE intends to address any potentially NRHP-eligible cultural resources that could be recorded in areas affected by the Project through the Section 106 process, as appropriate. DOE intends that compliance with Section 106 would address potential adverse effects to cultural resources that qualify as historic properties during operations and maintenance or decommissioning.

Following decommissioning, removal of Project transmission structures, conductors, and converter stations that may have caused visual alterations to aboveground historic and cultural resources such as buildings and structures would benefit those resources.

3.9.6.2 Impacts Associated with the Applicant Proposed Project

3.9.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.9.6.2.1.1 Construction Impacts

The ROI for the Oklahoma and Tennessee Converter Station Siting Areas and associated AC interconnection contain no previously recorded archaeological sites or other historic properties. Cultural resources surveys would be performed prior to construction to ascertain whether any unrecorded NRHP-eligible properties are present and to assess the possible impacts of construction on such resources if present. DOE intends to establish the timing and protocols for cultural resources surveys in a PA.

3.9.6.2.1.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance activities at the Oklahoma and Tennessee converter stations and AC interconnections (see Section 3.9.6.1.3).

3.9.6.2.1.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.2.2 AC Collection System

The AC collection system is located in the high plains of the Oklahoma and Texas panhandles. The frequency of inventoried historic and cultural resources per mile of ROI appears to be low based on available information (Table 3.9-15). Land cover data show that the AC collection system is located in open terrain, which is divided between cultivated crops (in land cover Group A) and rangelands (in land cover Group B) (Table 3.9-16). Overall, available information appears to suggest that the potential for the Project to impact historic and cultural resources is relatively low.

Table 3.9-15:
Frequency Per Linear Mile of AC Collection System Route Centerline for Previously Inventoried Historic and Cultural Resources by Project Alternative in Region 1

	AC Collection System Routes												
	E-1	E-2	E-3	NE-1	NE-2	SE-1	SE-2	SE-3	NW-1	NW-2	SW-1	SW-2	W-1
Length (miles)	28.94	39.82	39.95	30.05	26.28	40.34	13.44	49.09	51.89	56.01	13.39	37.03	20.74
Total Archaeological Sites (n)[1]	1	1	1	0	0	0	0	1	2	2	0	3	2
Total Aboveground Historic Properties (n)[1]	0	0	0	0	0	0	0	0	0	1	0	0	0
Archaeological Sites per Mile[2]	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.02	0.04	0.04	0.00	0.08	0.10
Historic Properties per Mile[2]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00

1 Area analyzed for archaeological sites is a 1,000-foot corridor, and for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-16:
Percentages of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources for AC Collection Routes in Region 1

Land Cover Group[1]	AC Collection Route												
	E-1	E-2	E-3	NE-1	NE-2	SE-1	SE-2	SE-3	NW-1	NW-2	SW-1	SW-2	W-1
A (Manipulated Terrain)	11.6%	33.4%	28.7%	54.4%	24.3%	50.6%	52.0%	41.3%	46.5%	47.5%	3.1%	17.5%	23.5%
B (Open Vegetation Patterns)	88.3%	66.4%	71.3%	45.6%	75.7%	49.4%	48.0%	58.5%	53.5%	52.4%	96.9%	82.5%	76.5%
C (Closed Vegetation Pattern)	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
W (Water)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Acres	708	974	977	730	637	1,265	1,365	979	325	1,194	326	901	508

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.

GIS Data Source: Jin et al. (2013)

3.9.6.2.2.1 Construction Impacts

Construction impacts are described in Section 3.9.6.1.1. Cultural resources survey within AC collection system would be performed prior to construction to assess the possible impacts of construction on such resources if present. DOE intends to establish the timing and protocols for cultural resources surveys in a PA. For sites discovered, the possible impacts of construction on such resources would be assessed. If historic properties are identified, efforts would be made to avoid, minimize or mitigate effects.

AC Collection System Routes NE-1, NE-2, SE-1, SE-2, and SW-1 contain no previously recorded archaeological sites or other historic properties.

AC Collection System Routes E-1, E-2, E-3, and SE-3 each contain one previously recorded archaeological site that has not been evaluated for NRHP eligibility. None contains previously recorded historic buildings.

AC Collection System Route NW-1 and NW-2 each contain two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. AC Collection System Route NW-1 contains no previously recorded historic buildings. The NRHP-listed Tracey Woodframe Grain Elevator is located in the vicinity of AC Collection System Route NW-2. Listed in 1983, aerial imagery (using Google Earth) from 2013 shows that the elevator has collapsed. Such severe loss of integrity may be sufficient to require delisting from the NRHP. The current condition of this property has not been field-verified, but if the elevator has collapsed, the loss of integrity would mean that any Project elements in the vicinity would not adversely affect the property.

AC Collection System Route SW-2 contains three previously recorded archaeological sites, none of which have been evaluated for NRHP eligibility. The route contains no previously recorded historic properties.

AC Collection System Route W-1 contains two previously recorded archaeological sites, neither of which has been evaluated for NRHP eligibility. The route contains no previously recorded historic properties.

3.9.6.2.2.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance of any of the AC collection system routes (see Section 3.9.6.1.3).

3.9.6.2.2.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.2.3 HVDC Applicant Proposed Route

Based on available information, the frequency of inventoried historic and cultural resources per mile of centerline along the Applicant Proposed Route varies, with higher frequencies occurring toward the eastern end of the Project, notably in Regions 4, 5, and 7 (Table 3.9-17), as more cultural resources surveys have taken place and more incidental finds have been recorded in these areas. Cultural resources field surveys would be conducted in all regions of the Applicant Proposed Route prior to construction to assess the possible impacts of construction on such resources if present. DOE intends to establish the timing and protocols for cultural resources surveys in a PA.

Land cover data show the increased extent of woodlands from Region 4, in eastern Oklahoma (Table 3.9-18). However, it is also evident that large areas of agricultural land occur in Regions 6 and 7. The implications of the available data are that Regions 4, 5, and 7 appear likely to contain the greatest numbers of historic and cultural resources. For sites discovered, the possible impacts of construction on such resources would be assessed through the measures outlined in the PA. If historic properties are identified, adverse effects would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

Table 3.9-17:
Frequency Per Linear Mile of the Applicant Proposed Route Centerline for Previously Inventoried Historic and Cultural Resources by Region

	Applicant Proposed Route (APR)						
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
Length (miles)	115.46	105.97	161.69	126.28	112.8	54.36	42.83
Total Archaeological Sites (n)[1]	4	0	2	20	13	5	14
Total Aboveground Historic Properties (n)[1]	6	9	20	8	0	0	0
Archaeological Sites per Mile[2]	0.03	0.00	0.01	0.16	0.12	0.09	0.33
Historic Properties per Mile[2]	0.01	0.00	0.01	0.05	0.20	0.02	0.93

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-18:
Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources for the HVDC Transmission Line by Region

Land Cover Group[1]	Applicant Proposed Route (APR)						
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7
A (Manipulated Terrain)	32.8%	39.7%	13.2%	5.6%	9.6%	85.8%	73.8%
B (Open Vegetation Patterns)	66.7%	50.5%	58.2%	50.6%	32.7%	0.4%	10.4%
C (Closed Vegetation Pattern)	0.2%	9.6%	28.3%	43.6%	57.3%	13.0%	13.7%
W (Water)	0.4%	0.2%	0.3%	0.2%	0.3%	0.9%	2.2%
Total Acres	2,926	2,687	4,328	3,570	3,051	1,448	1,221

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.

GIS Data Source: Jin et al. (2013)

3.9.6.2.3.1 Construction Impacts

3.9.6.2.3.1.1 Region 1

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential for containing a few to some historic and cultural resources in Region 1. Nearly all of the terrain is open (Table 3.9-18), which tends to reduce the need for extensive construction disturbances outside of transmission towers and other ground-level facilities. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved by consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The approximate 115-mile Applicant Proposed Route primarily traverses the interfluve between the Beaver River to the north and Wolf Creek to the south, intersecting the headwaters of several widely spaced minor tributaries of the Beaver River. In settings like that of the Applicant Proposed Route on the High Plains, the frequencies of cultural resources tend to be low, except in the vicinity of water sources, such as washes, creeks, rivers, and playas, where cultural resources, particularly prehistoric archaeological sites, may be more common. In contrast, pioneer settlement-era and statehood-period archaeological sites, buildings, and structures tend to be located along road networks, which are generally based on 1-mile section lines; terrain and water sources are thus somewhat less relevant to the distribution of cultural resources of later historic periods than they are to sites of earlier times. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but no associated cultural resources have been inventoried in any of these corridors in the vicinity of Project route intersections.

Terrain features related to drainage tend to be infrequent along most sections of the Applicant Proposed Route; the most notable exception to this generalization is the crossing of the Beaver River, where a higher frequency of cultural resources, and consequently a greater potential for Project impacts, may occur. Information on file with state and federal agencies confirms the presence of archaeological sites and historic buildings along the Applicant Proposed Route: inventoried properties include four archaeological sites and six historic buildings and structures. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but no associated cultural resources have been inventoried in any of these corridors in the vicinity of their intersections with the Project. The Applicant Proposed Route contains no identified NRHP-listed or -eligible properties.

3.9.6.2.3.1.2 Region 2

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain a few historic and cultural resources in Region 2. The great majority of terrain is open (Table 3.9-18), which tends to reduce the need for extensive construction disturbances outside of transmission towers and other ground-level facilities. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The approximate 106-mile Applicant Proposed Route parallels the North Canadian River along its approximately 55 westernmost miles, generally staying distant from the river on rolling plains. Much of this distance is located along the drainage divide with the Cimarron River to the north and east. It then enters the Cimarron River drainage via the headwaters of several minor tributaries of the river, crosses the Cimarron River and valley floor, and intersects the middle reaches of two tributary creeks of the river. In settings like that of the Applicant Proposed Route on the High Plains, the frequencies of cultural resources tend to be low, except in the vicinity of water sources, such as washes, creeks, rivers, and playas, where cultural resources, particularly prehistoric archaeological sites, may be more common. In contrast, pioneer settlement-era and statehood-period archaeological sites, buildings, and structures tend to be located along road networks, which are generally based on 1-mile section lines; terrain and water sources are thus somewhat less relevant to the distribution of cultural resources of later historic period than they are to sites of earlier times.

While much of the Applicant Proposed Route is situated on rolling plains distant from such terrain features, the route does cross several drainages, including headwaters and middle reaches of several creeks and the Cimarron River itself. Such locations have a higher potential to contain cultural resources and a greater potential for Project impacts. Information on file with state and federal agencies, however, suggests the overall low frequency of cultural resources along the Applicant Proposed Route; there are no inventoried archaeological sites or historic buildings and structures (Table 3.9-17). The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but no associated cultural resources or NRHP-listed or -eligible properties have been inventoried in any of these corridors in the vicinity of their intersections with the Project.

3.9.6.2.3.1.3 Region 3

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain a moderate number of cultural resources in Region 3. While much of the terrain is open, wooded areas compose around one-quarter of the terrain (Table 3.9-18).

The approximate 162-mile Applicant Proposed Route traverses gently rolling to broken terrain, intersecting numerous small drainages. The route also crosses the Cimarron River near Ripley, Oklahoma, and terminates on the western bank of the Arkansas by Webbers Falls Dam in Muskogee County, Oklahoma. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines), but with one exception associated with the U.S. Highway 66 National Historic Trail near Bristow, Oklahoma, no associated cultural resources have been inventoried in any of these corridors in the vicinity of the Applicant Proposed Route. Region 3 is the longest of the seven regions encompassing the Project—more than 25 percent longer than the second longest region, Region 4—and there are more inventoried historic and cultural resources in the Applicant Proposed Route in Region 3 than in the regions to the west. For any additional sites discovered, the possible impacts of construction on such resources would be assessed.

While there is reason to anticipate that cultural resources would be relatively common in Region 3, information on file with state and federal agencies does not reflect a high resource frequency (Table 3.9-17). Only two archaeological sites have been recorded within a portion of the ROI in this region to date, and no historic buildings have been inventoried. One historic structure, an NRHP-eligible segment of the 1926 original concrete-paved roadway (now abandoned) of U.S. Route 66, occurs as near as 0.5 mile from the Applicant Proposed Route near Bristow, Oklahoma.

3.9.6.2.3.1.4 Region 4

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain moderate numbers of historic and cultural resources in Region 4. The terrain is a roughly equal mix of open and wooded areas (Table 3.9-18).

The approximate 126-mile Applicant Proposed Route traverses undulating to hilly terrain along the northern edge of the Arkansas River valley. At the western end of Region 4, the Project alignment crosses the river itself at Webbers Falls Dam in Muskogee County, Oklahoma. The alignment then roughly parallels the river at a varying distance of approximately 2.25 to 17.5 miles. The route intersects numerous small drainages that flow from the rugged Boston Mountains to the north across the Arkansas Valley to confluences with the Arkansas River. In terrain such as that of Region 4, cultural resources may occur in a variety of settings. However, there is likely a tendency for the number of cultural resources, specifically prehistoric archaeological sites, to be greatest in the vicinity of water-related features, such as ravines, creeks, rivers, wetlands, and ponds. While water-related features might also have affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks. Unlike Oklahoma, where local road networks are generally based on 1-mile section lines, in western Arkansas geographic features such as stream and river courses and the ruggedness of the terrain appear to have played a dominant role influencing the locations of roads and settlements. The Applicant Proposed Route crosses several historic transportation corridors (trails and railroad lines). The most prominent of these is the Trail of Tears National Historic Trail (a multi-branched resource management corridor), specifically the Bell-Drane Route of the trail, over which approximately 2,000 Native Americans traveled into exile in Indian Territory (the future state of Oklahoma) in three separate parties in 1838 and 1839. In addition, one property in the Applicant Proposed Route ROI is listed on the NRHP:

- Mulberry River Bridge, Pleasant Hill vicinity, Crawford County, Arkansas

The property is located 0.28 mile off the centerline of the Applicant Proposed Route. The property could be subject to visual impacts from the construction of the proposed HVDC transmission line, if it substantially alters the bridge's historic setting. Analysis of this potential impact would occur prior to construction. Adverse effects, if any, would be resolved by means of avoidance, minimization, or mitigation. Tribal consultation also suggested specific potential for the location of burials and ceremonial grounds along the Applicant Proposed Route.

Taken in combination, these factors suggest that the number of cultural resources is likely higher along the Applicant Proposed Route in Region 4 than in Regions 1 and 2, perhaps somewhat higher than in Region 3, and similar to or somewhat lower than in Regions 5, 6, and 7. For sites discovered, the possible impacts of construction on such resources would be assessed.

The archaeological sensitivity of the Applicant Proposed Route and of Region 4 in general is suggested by the 20 inventoried archaeological sites that have been documented for the Applicant's Proposed Route ROI (Table 3.9-17), all of which are located in the western half of the Applicant Proposed Route, as far east as approximately the Crawford-Franklin county line in Arkansas. These 20 sites span a variety of types and periods and include prehistoric period general artifact scatters (7) and open camps (3), historic period farmsteads (2) and unidentified features (1), and multicomponent (mixed historic and prehistoric period) artifact scatters (5) and prehistoric sites co-occurring with historic period farmsteads (2). There are also several inventoried historic buildings and structures, none of which is NRHP listed or known to be eligible for the Arkansas Register of Historic Places. The Applicant Proposed Route intersects the Bell-Drane Route of the Trail of Tears in approximately six places between western Crawford and eastern Franklin counties. No cultural resources have been previously documented in the vicinity of any of the intersections.

3.9.6.2.3.1.5 Region 5

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain moderate numbers of historic and cultural resources in Region 5. A majority of the terrain is wooded, but open areas account for well over one-third of the alignment (Table 3.9-18).

The approximate 113-mile Applicant Proposed Route traverses hilly terrain along the southern fringe of the Ozark Plateau, which flanks northern edge of the Arkansas Valley. The alignment intersects numerous small and large drainages that flow off the Ozark Plateau toward Arkansas River or, at the eastern end of this region, more directly toward the Mississippi. While water-related features might also have affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks. In western and central Arkansas, geographic features such as stream- and river courses and the ruggedness of the terrain appear to have played a dominant role influencing the locations of roads and settlements, rather than public lands section lines, as is characteristic of states to the west and north. Consequently, the intervals at which the Project alignment crosses roads—and thus has a somewhat increased chance of the presence of historic period cultural resources—are apt to be more irregular than in Regions 1, 2, and 3, where section line roads dominate. No historic transportation corridors (trails and railroad lines) have been identified in the ROI for Region 5. Taken in combination, these factors suggest that the number of historic and cultural resources is likely similar to that of Region 4. For sites discovered, the possible impacts of construction on such resources would be assessed. If historic properties are identified, adverse effects would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The archaeological sensitivity of the Applicant Proposed Route and of Region 5 generally is confirmed by the 12 inventoried archaeological sites that have been documented for the Applicant's Proposed Route ROI. These 12 sites span a variety of types and periods and include prehistoric period general artifact scatters (6), open camps (1), and rockshelters (1); historic period farmsteads (2) and other structures (2); and multicomponent (mixed historic and prehistoric period) artifact scatters (1). There are also 18 inventoried historic buildings and structures. The prehistoric rockshelter site and one of the inventoried historic buildings or structures, both at undisclosed locations, are reported to be NRHP-eligible (Clean Line 2013, Table 3-25). In addition, two properties in the Applicant Proposed Route ROI are listed on the NRHP:

- Wesley Marsh House, Letona vicinity, White County, Arkansas
- William Henry Watson Homestead, Bradford vicinity, White County, Arkansas

Each property is located about 0.34 mile off the centerline of the Applicant Proposed Route and could be subject to visual impacts from the construction of the proposed HVDC transmission line. Analysis of this potential impact would occur prior to construction. Adverse effects, if any, would be resolved through consultation with consulting parties to develop means of avoidance, minimization or mitigation.

3.9.6.2.3.1.6 Region 6

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain moderate numbers of historic and cultural resources in Region 6. This assessment is based upon information on file with the respective SHPOs and NPS, as no cultural resources surveys of this portion of the Project have been completed to date. This region contains the highest proportion of cultivated crops (Table 3.9-18), which are open and generally present good transportation access.

The approximate 54-mile Applicant Proposed Route traverses the Lower Mississippi Alluvial Valley and crosses Holocene epoch riverine meander belts; Pleistocene epoch valley train deposits; and Crowley's Ridge, a string of low hills. The alignment intersects the Cache and White rivers and numerous small low-order drainages. The pre-agricultural terrain of the region contained numerous wetlands, sloughs, and oxbows. In terrain such as that of Region 6, cultural resources may occur in a variety of settings. However, soil drainage is likely to be a critical factor in the frequently flooded lower Mississippi Valley, with areas of good drainage preferentially occupied over more poorly drained areas, during both prehistoric and historic times. While water-related features doubtless affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks, which, while generally following a grid pattern in Region 6, tend to be irregularly spaced. Consequently, the intervals at which the Project alignment crosses roads are apt to be more irregular than in Regions 1, 2, and 3, where section line roads dominate. No historic transportation corridors (trails and railroad lines) have been identified in the ROI for Region 6. It should also be noted that the natural environment of this region is dynamic, with flooding from the Mississippi River and its major tributaries occurring frequently. Such alluvial activity may tend to remove or obscure archaeological resources, and the combination of the natural dynamism of the area and intensive agriculture may account for the decrease in the number of historic and cultural resources in Region 6 as compared to the regions to the east and west (Table 3.9-17). For sites discovered, the possible impacts of construction on such resources would be assessed. If historic properties are identified, adverse effects would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The archaeological sensitivity of the Applicant Proposed Route and of Region 6 is evidenced by the five archaeological sites (four prehistoric archaeological sites and one historic period archaeological site) that have been documented for the route. In addition, one historic building or structure has been inventoried along the Applicant Proposed Route ROI. This alignment contains no NRHP-listed properties.

3.9.6.2.3.1.7 Region 7

Based upon information on archaeological, historical, and tribal resources available from background research as presented in Table 3.9-17, the Applicant Proposed Route appears to have an overall potential to contain numerous cultural resources in Region 7. This assessment is based upon information on file with the respective SHPOs and NPS, as no cultural resources surveys of this portion of the Project have been completed to date. A majority of the Project alignment is cultivated crops or other open terrain, but wooded areas comprise around one-quarter of the Project ROI (Table 3.9-18).

The approximate 43-mile Applicant Proposed Route in Region 7 traverses the Lower Mississippi Alluvial Valley and crosses Holocene epoch riverine meander belts before climbing an escarpment on the right (eastern) side of the Mississippi River onto the West Tennessee Plateau Slope (part of the Southeastern Coastal Plain). This alignment crosses the Mississippi River and begins its climb onto the West Tennessee Plateau. Approximately three-quarters of the Applicant Proposed Route in Region 7 is located on Mississippi bottomlands. In bottomlands terrain like that found in the western and central portions of Region 7, cultural resources may occur in a variety of settings. However, soil drainage is likely to be a critical factor in the frequently flooded lower Mississippi valley, with areas of good drainage preferentially occupied over more poorly drained areas, during both prehistoric and historic times. In the hilly eastern portion of this region, there is likely a tendency for the number of cultural resources, specifically prehistoric archaeological sites, to be greatest in the vicinity of water-related features, such as ravines, creeks, rivers, wetlands, and ponds. While water-related features doubtless affected the locations of certain pioneer settlement-era and statehood-period archaeological sites, buildings, and structures, resources of the historic period tend to be located along road networks. In the western and central portions of Region 7, the road network tends to follow a grid pattern, while in the eastern portion, geographic features such as stream courses and the roughness of terrain strongly influence the form of the road network. In consequence, the intervals at which the Project alignment crosses roads are apt to be more irregular than in Regions 1, 2, and 3, where section line roads dominate. No historic transportation corridors (trails and railroad lines) have been identified in the ROI for Region 7. Such alluvial activity may tend to remove or obscure archaeological resources. Region 7 has the highest frequencies of both inventoried archaeological sites and inventoried aboveground historic properties (Table 3.9-17). For sites discovered, the possible impacts of construction on such resources would be assessed.

The archaeological sensitivity of the Applicant Proposed Route and of Region 7 generally is confirmed by the 14 inventoried archaeological sites and 40 inventoried historic buildings and structures that have been documented for The Applicant's Proposed Route in Region 7. The 14 archaeological sites include prehistoric period general artifact scatters (8) and villages (2), as well as general artifact scatters for the historic period (4, 2 of which also yield prehistoric artifacts). The large number of inventoried historic buildings and structures within the ROI for the Applicant Proposed Route in Region 7 reflects the location of the eastern end of the Project near the outskirts of Memphis, Tennessee; none has been evaluated for NRHP eligibility. The Applicant Proposed Route contains no NRHP-listed properties. The overall number or density of cultural resources that may be affected by the Project cannot be estimated from the available background information.

3.9.6.2.3.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance of the Applicant Proposed Route in Regions 1 through 7 (see Section 3.9.6.1.3).

3.9.6.2.3.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.3 Impacts Associated with the DOE Alternatives

3.9.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.9.6.3.1.1 Construction Impacts

The Arkansas Converter Station Alternative Siting Area ROI contains 23 previously recorded archaeological sites, including 2 that have been recommended as eligible for the NRHP and 21 that have no eligibility recommendation. There are also three previously recorded historic buildings, none of which has been evaluated for NRHP eligibility. The number of previously recorded cultural resources suggests a moderate to high sensitivity for the presence of sites that may be affected by the project construction. Design of the converter station would avoid currently known NRHP-eligible properties.

The cultural resources sensitivity of the Arkansas Converter Station AC interconnection is comparable to that described for the Arkansas Converter Station Alternative Siting Area ROI. Following cultural resources surveys, the Project design would attempt to avoid impacts to NRHP-eligible cultural resources. If avoidance is not possible, appropriate mitigation of adverse impacts to NRHP-eligible cultural resources would be performed in consultation with the appropriate SHPOs and Indian Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking.

3.9.6.3.1.2 Operations and Maintenance Impacts

No impacts would result from operations and maintenance of the Arkansas Converter Station or AC interconnection (see Section 3.9.6.1.3).

3.9.6.3.1.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.3.2 HVDC Alternative Routes

3.9.6.3.2.1 Construction Impacts

Comparisons of the historic and cultural resources along the HVDC alternative routes with the Applicant Proposed Routes are presented in the sections that follow based on the data summarized by region in the associated tables. As described for the Applicant Proposed Route, cultural resources field surveys would be conducted in all HVDC alternative routes prior to construction to assess the possible impacts of construction on such resources if present. DOE intends to establish the timing and protocols for cultural resources surveys in a PA. Across all HVDC alternative routes, with effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to historic properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

3.9.6.3.2.1.1 Region 1

3.9.6.3.2.1.1.1 Alternative Route 1-A

HVDC Alternative Route 1-A loops to the north of the Applicant Proposed Route, and the alternative route is longer (by 9.42 miles) than the corresponding links of the Applicant Proposed Route. While the greater length of the alternative route alone would somewhat increase its potential to impact cultural resources, its geographic location also contributes to its increased potential for impacting these resources. Unlike the corresponding links of the Applicant Proposed Route, which primarily traverses an interfluve between adjoining drainage basins, HVDC Alternative Route 1-A is located much closer to the Beaver River, where greater numbers of prehistoric archaeological sites and perhaps other types of cultural resources might be found. Information on file with state and federal agencies confirms the greater frequency of inventoried archaeological sites and shows an equal number of inventoried historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties.

While it appears that HVDC Alternative Route 1-A involves more cultivated crops than the equivalent links of the Applicant Proposed Route (Table 3.9-20), which might indicate an overall lower need for ground-disturbing terrain manipulation, the alternative appears to have a somewhat greater potential to contain historic and cultural resources than the corresponding links of the Applicant Proposed Route.

Table 3.9-19:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 1

		AR 1-A		AR 1-B		AR 1-C		AR 1-D	
	Region 1 APR	AR	APR Links 2, 3, 4, 5	AR	APR Links 2, 3	AR	APR Links 2, 3	AR	APR Links 3, 4
Length (miles)	115.46	122.97	113.55	51.86	53.83	52.03	53.83	33.45	33.57
Total Archaeological Sites (n)[1]	4	9	4	2	3	0	3	1	1
Total Aboveground Historic Properties (n)[1]	6	0	1	1	0	1	0	0	1
Archaeological Sites per Mile[2]	0.03	0.07	0.04	0.04	0.06	0.00	0.06	0.03	0.03
Historic Properties per Mile[2]	0.01	0.00	0.01	0.02	0.00	0.02	0.00	0.00	0.03

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-20:
Region 1 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1]	Region 1 APR	AR 1-A		AR 1-B		AR 1-C		AR 1-D	
		AR	APR Links 2, 3, 4, 5	AR	APR Links 2, 3	AR	APR Links 2, 3	AR	APR Links 3, 4
A (Manipulated Terrain)	32.8%	19.8%	33.3%	23.0%	46.3%	23.3%	46.3%	25.3%	16.6%
B (Open Vegetation Patterns)	66.7%	79.6%	66.1%	77.0%	53.7%	76.6%	53.7%	74.2%	82.9%
C (Closed Vegetation Pattern)	0.2%	0.4%	0.2%	0.0%	0.0%	0.1%	0.0%	0.5%	0.4%
W (Water)	0.4%	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Acres	2,926	3,168	2,875	1,315	1,361	1,333	1,361	848	845

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.

GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.1.2 Alternative Route 1-B

HVDC Alternative Route 1-B parallels the corresponding links of the Applicant Proposed Route to the north at a distance of up to approximately 7 miles. HVDC Alternative Route 1-B is shorter (by 1.97 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows similar numbers of inventoried archaeological sites and historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties. The alternative route appears to cross more cultivated crops than the Applicant Proposed Route (Table 3.9-20), which may indicate that existing access is somewhat better for the alternative.

Given the small difference in length between the two routes and the detail of the available information, the likely number of historic and cultural resources in HVDC Alternative Route 1-B is similar to the estimated low to moderate frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.1.3 Alternative Route 1-C

HVDC Alternative Route 1-C parallels the Applicant Proposed Route to the north at distances of up to approximately 7 miles. HVDC Alternative Route 1-C is shorter (by 1.80 miles) than the corresponding links of the Applicant Proposed Route, but it similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and a similar number of inventoried historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties. The alternative route appears to cross more cultivated crops than the Applicant Proposed Route (Table 3.9-20), which may indicate that existing access is somewhat better for the alternative.

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 1-C to contain cultural resources is similar to the estimated low to moderate frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.1.4 Alternative Route 1-D

HVDC Alternative Route 1-D parallels the Applicant Proposed Route to the south by approximately 0.5 mile. HVDC Alternative Route 1-D is approximately the same length (shorter by just 0.12 mile) as the corresponding links of the Applicant Proposed Route and traverses the same terrain. Information on file with state and federal agencies shows the same number of inventoried archaeological sites and a non-substantial difference in the number of inventoried historic buildings and structures (Table 3.9-19). Neither contains identified NRHP-listed or -eligible properties. Land cover appears similar between the two routes (Table 3.9-20).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 1-D to contain cultural resources is similar to the estimated low to moderate frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.2 Region 2

3.9.6.3.2.1.2.1 Alternative Route 2-A

HVDC Alternative Route 2-A parallels the Applicant Proposed Route to the north at a distance of up to approximately 11 miles. HVDC Alternative Route 2-A is longer (by 2.74 miles) than the corresponding link of the Applicant Proposed Route. The alternative route traverses similar terrain to that of the Applicant Proposed Route, but more of the alternative route is in the Cimarron River drainage and close to the river itself. The number of archaeological sites and inventoried historic buildings along HVDC Alternative Route 2-A and the Applicant Proposed Route are not substantially different (Table 3.9-21). Neither contains identified NRHP-listed or -eligible properties. Land cover between the Applicant Proposed Route and the alternative is broadly comparable, although the former appears to have both more cultivated crops and more woodland as compared to the latter (Table 3.9-22); these differences are minor and likely have little difference in terms of potential impacts to cultural resources.

The relatively small difference in length between the two routes and the available information suggest that the potential for HVDC Alternative Route 2-A to contain cultural resources is similar to the estimated low frequencies of the Applicant Proposed Route. However, the proximity of the roughly 13.6-mile section of HVDC Alternative Route 2-A, approximately 1.0 to 2.5 miles from the Cimarron River, may slightly increase the overall cultural resources sensitivity or potential of this route as compared to the corresponding link of the Applicant Proposed Route.

Table 3.9-21:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 2

	Region 2 APR	AR 2-A		AR 2-B	
		AR	APR Link 2	AR	APR Link 3
Length (miles)	105.97	57.16	54.42	29.75	31.23
Total Archaeological Sites (n)[1]	0	2	0	0	0
Total Aboveground Historic Properties (n)[1]	0	2	0	0	0
Archaeological Sites per Mile[2]	0	0.03	0.00	0.00	0.00
Historic Properties per Mile[2]	0	0.03	0.00	0.00	0.00

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-22:
Region 2 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1]	Region 2 APR	AR 2-A		AR 2-B	
		AR	APR Link 2	AR	APR Link 3
A (Manipulated Terrain)	39.7%	29.1%	36.3%	63.7%	63.2%
B (Open Vegetation Patterns)	50.5%	60.5%	46.4%	33.2%	34.4%
C (Closed Vegetation Pattern)	9.6%	9.9%	16.9%	2.2%	2.4%
W (Water)	0.2%	0.4%	0.4%	1.0%	0.0%
Total Acres	2,687	1,480	1,370	759	786

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.

GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.2.2 Alternative Route 2-B

HVDC Alternative Route 2-B parallels the Applicant Proposed Route to the north for up to approximately 3.5 miles. HVDC Alternative Route 2-B is shorter (by 1.48 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows no cultural resources have been recorded along the Applicant Proposed Route or HVDC Alternative Route 2-B (Table 3.9-21). Land cover along the Applicant Proposed Route and along the alternative is highly similar (Table 3.9-22).

Given the small difference in length between the two routes the similarity in land cover, and the available information the potential for HVDC Alternative Route 2-B to contain cultural resources is similar to the estimated low frequencies of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.3 Region 3

3.9.6.3.2.1.3.1 Alternative Route 3-A

HVDC Alternative Route 3-A parallels the Applicant Proposed Route to the northeast for up to approximately 7.5 miles. HVDC Alternative Route 3-A is shorter (by 2.41 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows no cultural resources have been recorded along the Applicant Proposed Route or HVDC Alternative Route 3-A (Table 3.9-23). There are strong similarities between the land cover of both (Table 3.9-24).

Given the small difference in length between the two routes the similarity in land cover, and the available information, the potential for HVDC Alternative Route 3-A to contain cultural resources is similar to the estimated low frequencies of the corresponding link of the Applicant Proposed Route.

Table 3.9-23:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 3

		AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
	Region 3 APR	AR	APR Link 1	AR	APR Links 1, 2, 3	AR	APR Links 3, 4, 5, 6	AR	APR Links 5, 6	AR	APR Link 6
Length (miles)	161.69	37.61	40.02	47.73	49.92	121.63	118.56	39.33	35.08	8.49	7.74
Total Archaeological Sites (n)[1]	2	0	0	1	0	5	2	1	1	0	0
Total Aboveground Historic Properties (n)[1]	20	0	0	0	0	2	2	2	0	0	0
Archaeological Sites per Mile[2]	0.01	0.00	0.00	0.02	0.00	0.04	0.02	0.03	0.03	0.00	0.00
Historic Properties per Mile[2]	0.01	0.00	0.00	0.00	0.00	0.02	0.02	0.05	0.00	0.00	0.00

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-24:
Region 3 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

		AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
Land Cover Group[1]	Region 3 APR	AR	APR Link 1	AR	APR Links 1, 2, 3	AR	APR Links 3, 4, 5, 6	AR	APR Links 5, 6	AR	APR Link 6
A (Manipulated Terrain)	13.2%	22.8%	27.3%	21.2%	25.9%	8.2%	8.5%	9.3%	4.5%	4.1%	5.6%
B (Open Vegetation Patterns)	58.2%	54.9%	48.6%	58.6%	50.1%	61.8%	60.8%	70.5%	75.9%	59.1%	50.1%
C (Closed Vegetation Pattern)	28.3%	21.5%	23.7%	19.5%	23.7%	29.7%	30.4%	19.8%	19.4%	35.6%	44.2%
W (Water)	0.3%	0.8%	0.4%	0.6%	0.3%	0.3%	0.3%	0.4%	0.3%	1.2%	0.1%
Total Acres	4,328	959	1,060	1,251	1,336	3,188	3,183	1,041	949	233	214

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.3.2 Alternative Route 3-B

HVDC Alternative Route 3-B parallels the Applicant Proposed Route to the northeast for up to approximately 7.5 miles. HVDC Alternative Route 3-A is shorter (by 2.19 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites. Neither contains any inventoried historic buildings or structures (Table 3.9-23). There are strong similarities between the land cover of the Applicant Proposed Route and that of the alternative (Table 3.9-24).

Given the small difference in length between the two routes the similarity in land cover, and the available information, the potential for HVDC Alternative Route 3-B to contain cultural resources is similar to the estimated low frequencies of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.3.3 Alternative Route 3-C

HVDC Alternative Route 3-C parallels the Applicant Proposed Route to the southwest for up to approximately 9.25 miles. HVDC Alternative Route 3-C is longer (by 3.07 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain with similar land cover (Table 3.9-24). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites (Table 3.9-23). Both cross the historic U.S. Route 66 corridor about 5.3 miles west-southwest of Bristow. No inventoried cultural resources are associated with the historic highway in the vicinity of this intersection. HVDC Alternative Route 3-C passes within approximately 0.10 to 0.29 mile of two NRHP-listed properties, one of which is also an NHL:

- Oktaha School, Muskogee County, Oklahoma (NRHP) (within 0.29 mile)
- Honey Springs Battlefield, MacIntosh and Muskogee Counties, Oklahoma (NRHP/NHL) (within 0.10 mile)

Depending on local terrain and vegetation and the size and design of Project structures in the vicinity of these properties, construction of HVDC Alternative Route 3-C could result in visual impacts if it substantially alters the historic setting of one or both of these properties. Therefore, given the available background information, HVDC Alternative Route 3-C has a higher potential to cause construction-related Project impacts than the corresponding links of the Applicant Proposed Route. Aside from potential Project impacts associated with the two NRHP-listed properties, the overall potential for HVDC Alternative Route 3-C to contain historic and cultural resources is similar to the estimated moderate impact potential of the corresponding links of the Applicant Proposed Route, given the modest difference in length between the two routes and the available information.

3.9.6.3.2.1.3.4 Alternative Route 3-D

HVDC Alternative Route 3-D parallels the Applicant Proposed Route to the south for approximately 9 miles. HVDC Alternative Route 3-D is longer (by 4.25 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain with similar land cover (Table 3.9-24). Information on file with state and federal agencies shows the same number of inventoried archaeological sites. Two historic buildings or structures have been inventoried within the ROI for HVDC Alternative Route 3-D, which is similar to the absence of inventoried historic buildings and structures along the corresponding links of the Applicant Proposed Route (Table 3.9-23). HVDC Alternative Route 3-D passes within approximately 0.10 to 0.29 mile of two NRHP-listed properties, one of which is also an NHL:

- Oktaha School, Muskogee County, Oklahoma (NRHP) (within 0.29 mile)
- Honey Springs Battlefield, MacIntosh and Muskogee Counties, Oklahoma (NRHP/NHL) (within 0.10 mile)

Depending upon local terrain and vegetation and the size and design of Project structures in the vicinity of these properties, construction of HVDC Alternative Route 3-D could result in visual impacts if it substantially alters the historic setting of one or both of these properties. Therefore, given the available information, HVDC Alternative Route 3-D has a higher potential to cause construction-related Project impacts than the corresponding links of the Applicant Proposed Route. Aside from potential Project impacts associated with the two NRHP-listed properties, the overall potential for HVDC Alternative Route 3-D to contain historic and cultural resources is similar to the estimated moderate numbers of historic and cultural resources of the corresponding links of the Applicant Proposed Route given the modest difference in length between the two routes and the available information.

3.9.6.3.2.1.3.5 Alternative Route 3-E

HVDC Alternative Route 3-E parallels the Applicant Proposed Route up to approximately 1 mile to the south at the eastern terminus of this region. HVDC Alternative Route 3-E is longer (by 0.75 mile) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows that no cultural resources have been recorded along the Applicant Proposed Route or HVDC Alternative Route 3-E (Table 3.9-23). There are strong similarities between the land cover of the Applicant Proposed Route and that of the alternative (Table 3.9-24).

Given the small difference in length between the two routes and the similarity in land cover, the potential for HVDC Alternative Route 3-E to contain historic and cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.4 Region 4

3.9.6.3.2.1.4.1 Alternative Route 4-A

HVDC Alternative Route 4-A parallels the Applicant Proposed Route to the north for approximately 5.75 miles. HVDC Alternative Route 4-A is shorter (by 1.98 miles) than the corresponding links of the Applicant Proposed Route and traverses somewhat more rugged terrain across the foothills of the Brush Mountains, part of the Boston Mountains region. Information on file with state and federal agencies shows that fewer archaeological sites have been inventoried in the area of HVDC Alternative Route 4-A as compared to the corresponding links of the Applicant Proposed Route, and that an equal number of buildings have been inventoried (Table 3.9-25). The alternative alignment intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-A includes no NRHP-listed properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-26). Wooded terrain may somewhat reduce the potential of visual effects on historic properties through vegetative screening, but also requires more ground disturbance for ROW clearing, road construction, and similar activities, increasing the possibility of effects to archaeological resources.

Table 3.9-25:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 4

		AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
	Region 4 APR	AR	APR Links 3, 4, 5, 6	AR	APR Links 2, 3, 4, 5, 6, 7, 8	AR	APR Link 5	AR	APR Links 4, 5, 6	AR	APR Links 8, 9
Length (miles)	126.28	58.40	60.38	78.60	81.26	3.37	2.15	25.32	25.34	36.72	38.73
Total Archaeological Sites (n)[1]	20	9	19	25	19	0	0	1	9	7	1
Total Aboveground Historic Properties (n)[1]	8	2	2	4	3	0	0	3	2	3	3
Archaeological Sites per Mile[2]	0.16	0.15	0.31	0.32	0.23	0.00	0.00	0.04	0.36	0.19	0.03
Historic Properties per Mile[2]	0.05	0.03	0.03	0.05	0.04	0.00	0.00	0.12	0.08	0.08	0.08

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-26:
Region 4 HVDC Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1]	Region 4 APR	AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
		AR	APR Links 3, 4, 5, 6	AR	APR Links 2, 3, 4, 5, 6, 7, 8	AR	APR Link 5	AR	APR Links 4, 5, 6	AR	APR Links 8, 9
A (Manipulated Terrain)	5.6%	2.7%	7.1%	3.0%	6.2%	2.8%	3.1%	3.8%	14.0%	5.7%	3.7%
B (Open Vegetation Patterns)	50.6%	44.9%	56.0%	32.5%	54.8%	28.5%	31.2%	51.7%	56.8%	49.9%	47.5%
C (Closed Vegetation Pattern)	43.6%	52.2%	36.8%	64.4%	38.9%	68.8%	65.7%	44.5%	29.0%	44.4%	48.8%
W (Water)	0.2%	0.1%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%
Total Acres	3,570	1,615	1,735	2,119	2,306	108	59	740	751	1,044	1,089

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.

GIS Data Source: Jin et al. (2013)

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-A to contain cultural resources is approximately the same or somewhat higher as compared to the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.4.2 Alternative Route 4-B

HVDC Alternative Route 4-B parallels the Applicant Proposed Route to the north by up to approximately 7.5 miles. HVDC Alternative Route 4-B is shorter (by 2.66 miles) than the corresponding links of the Applicant Proposed Route and traverses somewhat more rugged terrain across the foothills of the Brush Mountains, part of the Boston Mountains region. Information on file with state and federal agencies shows that more archaeological sites have been inventoried in the area of proposed HVDC Alternative Route 4-B as compared to the equivalent corresponding links of the Applicant Proposed Route, and roughly equal numbers of buildings have been inventoried (Table 3.9-25). The alternative alignment intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-B includes no NRHP-listed properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-26). HVDC Alternative Route 4-B includes one NRHP-listed property situated in the vicinity of Cedarville, Arkansas:

- Butterfield Overland Mail Route—Lucian Wood Road Segment, Crawford County, Arkansas

HVDC Alternative Route 4-B has the potential to cause adverse visual impacts to this property if its construction substantially alters the historic setting of the road, which is situated within approximately 0.08 mile of the ROI centerline. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-B to contain cultural resources is approximately the same or somewhat higher as compared to the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.4.3 Alternative Route 4-C

HVDC Alternative Route 4-C loops to the south of the Applicant Proposed Route at State Highway 59 north of Fort Smith-Van Buren up to approximately 1 mile away from the Applicant Proposed Route. This route avoids a subdivision now under development. HVDC Alternative Route 4-C is longer (by 1.22 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain with similar land cover (Table 3.9-26). Information on file with state and federal agencies shows that no cultural resources have been recorded along the Applicant Proposed Route or this alternative (Table 3.9-25). The HVDC Alternative Route 4-C intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-C includes no NRHP-listed properties.

Given the small difference in length between the two routes the similarity of land cover, and the available information, the potential for HVDC Alternative Route 4-C to contain cultural resources is similar to the estimated moderate to medium-high numbers of historic and cultural resources of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.4.4 Alternative Route 4-D

HVDC Alternative Route 4-D loops to the north of the Applicant Proposed Route by up to approximately 8.25 miles. HVDC Alternative Route 4-D is the same length as the corresponding links of the Applicant Proposed Route (0.02 mile shorter) but it traverses somewhat more rugged terrain across the foothills of the Brush Mountains, part of the Boston Mountains region. Information on file with state and federal agencies shows that fewer archaeological sites have been inventoried in the area of proposed HVDC Alternative Route 4-D as compared to the equivalent corresponding links of the Applicant Proposed Route, and non-substantially more buildings have been inventoried (Table 3.2-25). The alternative alignment intersects the Bell-Drane Route of the Trail of Tears north of Fort Smith-Van Buren, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection. HVDC Alternative Route 4-D includes no NRHP-listed properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-26).

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-D to contain cultural resources is approximately the same or somewhat higher as compared to the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.4.5 Alternative Route 4-E

HVDC Alternative Route 4-E parallels to the south the Applicant Proposed Route at a distance of up to approximately 4 miles. HVDC Alternative Route 4-E is shorter (2.01 miles) than the equivalent section of the Applicant Proposed Route. HVDC Alternative 4-E traverses similar terrain to the Applicant Proposed Route with similar land cover (Table 3.9-26), but is situated closer to the Arkansas River. Information on file with state and federal agencies shows that more archaeological sites have been inventoried in the area of proposed HVDC Alternative Route 4-E as compared to the corresponding links of the Applicant Proposed Route and that the two routes contain equal numbers of inventoried historic buildings and structures (Table 3.9-25). HVDC Alternative Route 4-E intersects the Bell-Drane Route of the Trail of Tears in south-central Johnson County, but no inventoried cultural resources are associated with the trail in the vicinity of this intersection.

HVDC Alternative Route 4-E includes two NRHP-listed properties situated 0.5 to 5 mile southeast of Hagarville, Arkansas:

- Lutherville School, Johnson County, Arkansas
- Munger House, Johnson County, Arkansas

HVDC Alternative Route 4-E has the potential to cause adverse visual impacts to these two properties if its construction substantially alters the historic setting of either, as they are situated within approximately 0.05 to 0.09 mile of the ROI centerline. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to these properties would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

Given the rough similarity in length between the two routes and the available information, the potential for HVDC Alternative Route 4-E to contain cultural resources may be somewhat greater than that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.5 Region 5

3.9.6.3.2.1.5.1 Alternative Route 5-A

HVDC Alternative Route 5-A parallels the Applicant Proposed Route to the north for up to just 0.7 mile. HVDC Alternative Route 5-A is approximately the same length (longer by 0.35 mile) as the equivalent section of the Applicant Proposed Route and traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological. Neither contains inventoried historic buildings or structures (Table 3.9-27). HVDC Alternative Route 5-A contains no identified NRHP-listed or -eligible properties. Land cover is very similar (Table 3.9-28).

Table 3.9-27:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 5

		AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F	
	Region 5 APR	AR	APR Link 1	AR	APR Links 3, 4, 5, 6	AR	APR Links 6, 7	AR	APR Link 9	AR	APR Links 4, 5, 6	AR	APR Links 5, 6
Length (miles)	112.8	12.62	12.27	70.96	67.07	9.19	9.39	21.71	20.46	36.26	33.11	22.33	18.73
Total Archaeological Sites (n)[1]	13	0	1	26	4	3	5	9	6	12	4	11	4
Total Aboveground Historic Properties (n)[1]	0	0	0	25	16	4	9	3	6	21	15	18	14
Archaeological Sites per Mile[2]	0.12	0.00	0.08	0.37	0.06	0.33	0.53	0.41	0.29	0.33	0.12	0.49	0.21
Historic Properties per Mile[2]	0.20	0.00	0.00	0.35	0.24	0.44	0.96	0.14	0.29	0.58	0.45	0.81	0.75

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-28:
Region 3 HVDC Alternative Routes—Percentages Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group1	Region 5 APR	AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F	
		AR	APR Link 1	AR	APR Links 3, 4, 5, 6	AR	APR Links 6, 7	AR	APR Link 9	AR	APR Links 4, 5, 6	AR	APR Links 5, 6
A (Manipulated Terrain)	9.6%	3.0%	2.3%	5.2%	5.1%	3.0%	3.8%	23.8%	34.7%	6.9%	5.4%	8.1%	6.6%
B (Open Vegetation Patterns)	32.7%	23.4%	24.9%	48.5%	40.8%	38.7%	32.4%	10.7%	20.9%	48.7%	46.2%	42.4%	33.9%
C (Closed Vegetation Pattern)	57.3%	73.6%	72.8%	46.3%	53.8%	58.1%	63.6%	64.3%	43.7%	44.4%	48.4%	49.5%	59.5%
W (Water)	0.3%	0.0%	0.0%	0.1%	0.3%	0.2%	0.2%	1.2%	0.7%	0.0%	0.0%	0.0%	0.0%
Total Acres	3,051	374	341	1,953	1,796	279	262	619	551	973	884	597	488

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.

GIS Data Source: Jin et al. (2013)

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 5-A to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.5.2 Alternative Route 5-B

HVDC Alternative Route 5-B parallels the Applicant Proposed Route to the south by up to approximately 3.5 miles. HVDC Alternative Route 5-B is longer (by 3.89 miles) than the equivalent section of the Applicant Proposed Route, but it traverses similar terrain with generally comparable land cover (Table 3.9-28). Information on file with state and federal agencies shows that substantially more archaeological sites and historic buildings and structures have been inventoried in the area of proposed HVDC Alternative Route 5-B as compared to the equivalent segment of the Applicant Proposed Route (Table 3.9-27). HVDC Alternative Route 5-B includes two NRHP-listed properties:

- Charlie Hall House, Damascus vicinity, Faulkner County, Arkansas
- New Mount Pisgah School, Letona vicinity, White County, Arkansas

Both properties could be subject to visual impacts from Project construction if it substantially alters their historical setting. The Hall House is less than 500 feet south of the ROI centerline for HVDC Alternative Route 5-B, while the New Mount Pisgah School is approximately 0.29 mile north of the ROI centerline for the alternative. The equivalent corresponding links of the Applicant Proposed Route do not contain NRHP-listed properties. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

The available information appears to indicate that construction-related impacts are more likely to occur from HVDC Alternative Route 5-B than from the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.5.3 Alternative Route 5-C

HVDC Alternative Route 5-C loops to the northwest of the Applicant Proposed Route for up to approximately 1.9 miles. HVDC Alternative Route 5-A is approximately the same length (shorter by 0.2 mile) as the equivalent section of the Applicant Proposed Route and traverses similar terrain, with similar land cover (Table 3.9-28). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and (Table 3.9-27). In addition, one property in the ROI of HVDC Alternative Route 5-C, located in the vicinity of Letona, Arkansas, is listed on the NRHP:

- Wesley Marsh House, White County, Arkansas

The property is located about 0.34 mile from the centerline of the alternative and could be subject to visual impacts from the construction of the proposed HVDC transmission line, if construction substantially alters the property's historic setting. Given the small difference in length between the two routes and available information, the potential for HVDC Alternative Route 5-C to contain cultural resources is similar to that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.5.4 Alternative Route 5-D

HVDC Alternative Route 5-D parallels the Applicant Proposed Route to the north at a distance of up to approximately 3 miles. HVDC Alternative Route 5-D is longer (by 1.25 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-27). HVDC Alternative Route 5-D contains no identified NRHP-listed or -eligible properties. The alternative route is more wooded than the corresponding links of the Applicant Proposed Route (Table 3.9-28).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 5-D to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route. However, the somewhat more extensive woodland cover of the alternative route possibly indicates an increased potential for construction-related impacts to archaeological resources.

3.9.6.3.2.1.5.5 Alternative Route 5-E

HVDC Alternative Route 5-E parallels the Applicant Proposed Route to the south at a distance of up to approximately 3.5 miles. HVDC Alternative Route 5-E is longer (by 3.15 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain, with generally similar land cover (Table 3.9-28). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological and inventoried historic buildings and structures (Table 3.9-27). HVDC Alternative Route 5-E contains one NRHP-listed property, located in the vicinity of Letona, Arkansas:

- New Mount Pisgah School, White County, Arkansas

The property, situated 0.29 mile from the centerline of the alternative route's ROI could be subject to visual impacts from the proposed HVDC transmission line, if construction substantially alters its historic setting. The corresponding links of the Applicant Proposed Route ROI also includes this NRHP-listed property. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation.

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 5-E to cause construction-related adverse effects to cultural resources appears to be similar or somewhat greater than the potential of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.5.6 Alternative Route 5-F

HVDC Alternative Route 5-F loops south of the Applicant Proposed Route at a distance of up to approximately 3.5 miles. HVDC Alternative Route 5-F is longer (by 3.6 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-27). HVDC Alternative Route 5-E contains one NRHP-listed property, located in the vicinity of Letona, Arkansas:

- New Mount Pisgah School, White County, Arkansas

The property, situated 0.29 mile from the centerline of the alternative route's ROI could be subject to visual impacts from the proposed HVDC transmission line if construction substantially alters its historic setting. With effective implementation of plans and measures such as those described in Section 3.9.6.1.1, adverse effects to this property would be resolved through consultation with consulting parties to develop means of avoidance, minimization, or mitigation. The corresponding links of the Applicant Proposed Route ROI also includes this NRHP-listed property. Comparison of land cover groups suggests that the alternative route traverses a somewhat more open landscape than the corresponding links of the Applicant Proposed Route (Table 3.9-28).

On balance, given the modest differences in length and land cover between the two routes and the available information, the potential for HVDC Alternative Route 5-F to contain cultural resources is likely roughly similar to that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.6 Region 6

3.9.6.3.2.1.6.1 Alternative Route 6-A

HVDC Alternative Route 6-A parallels the Applicant Proposed Route to the south for up to approximately 2.1 miles. HVDC Alternative Route 6-A is shorter (by 1.48 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and the same number of inventoried historic buildings and structures (Table 3.9-29). Like the Applicant Proposed Route, HVDC Alternative Route 6-A contains no identified NRHP-listed or -eligible properties. Both routes almost entirely traverse cultivated crops (Table 3.9-30).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 6-A to contain cultural resources is similar to that of the corresponding links of the Applicant Proposed Route.

Table 3.9-29:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 6

	Region 6 APR	AR 6-A		AR 6-B		AR 6-C		AR 6-D	
		AR	APR Links 2, 3, 4	AR	APR Link 3	AR	APR Links 6, 7	AR	APR Link 7
Length (miles)	54.36	16.18	17.66	14.11	9.61	23.12	24.80	9.15	8.57
Total Archaeological Sites (n)[1]	5	1	0	3	0	5	5	0	1
Total Aboveground Historic Properties (n)[1]	0	1	1	2	1	0	0	0	0
Archaeological Sites per Mile[2]	0.09	0.06	0.00	0.21	0.00	0.22	0.20	0.00	0.12
Historic Properties per Mile[2]	0.02	0.06	0.06	0.14	0.10	0.00	0.00	0.00	0.00

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Table 3.9-30:
Region 6 HVDC Transmission Line Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

Land Cover Group[1]	Region 6 APR	AR 6-A		AR 6-B		AR 6-C		AR 6-D	
		AR	APR Links 2, 3, 4	AR	APR Link 3	AR	APR Links 6, 7	AR	APR Link 7
A (Manipulated Terrain)	85.8%	88.4%	94.8%	85.2%	92.7%	79.4%	74.2%	92.7%	94.1%
B (Open Vegetation Patterns)	0.4%	0.0%	0.0%	0.5%	0.0%	4.0%	0.9%	0.0%	0.2%
C (Closed Vegetation Pattern)	13.0%	6.0%	4.1%	12.9%	6.1%	12.8%	24.2%	6.4%	3.9%
W (Water)	0.9%	5.6%	1.1%	1.3%	1.2%	3.8%	0.7%	0.8%	1.8%
Total Acres	1,448	458	477	376	257	616	644	241	230

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.6.2 Alternative Route 6-B

HVDC Alternative Route 6-B loops north up to approximately 3.5 miles from the Applicant Proposed Route. HVDC Alternative Route 6-B is longer (by 4.5 miles) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-29). Neither contains identified NRHP-listed or -eligible properties. Both routes almost entirely traverse cultivated crops (Table 3.9-30).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 6-B to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.6.3 Alternative Route 6-C

HVDC Alternative Route 6-C parallels the Applicant Proposed Route to the south for up to approximately 2.7 miles. HVDC Alternative Route 6-C is shorter (by 1.68 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows an identical number of inventoried archaeological sites and inventoried historic buildings and structures for HVDC Alternative Route 6-C as compared to the corresponding links of the Applicant Proposed Route (Table 3.9-29). Neither contains identified NRHP-listed or -eligible properties. HVDC Alternative Route 6-C traverses somewhat more open terrain than the Applicant Proposed Route, of which approximately one-quarter is situated in woodland (Table 3.9-30).

Given the small differences in length and land cover between the two routes, the potential for HVDC Alternative Route 6-C to contain cultural resources is similar or less than the potential of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.6.4 Alternative Route 6-D

HVDC Alternative Route 6-D parallels the Applicant Proposed Route approximately 1 mile to the northwest. HVDC Alternative Route 6-C is approximately the same length (longer by 0.58 mile) than the corresponding link of the Applicant Proposed Route, but it traverses similar terrain. Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites and no inventoried historic buildings or structures (Table 3.9-29). Neither contains identified NRHP-listed or -eligible properties. Both routes almost entirely traverse cultivated crops (Table 3.9-30).

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 6-D to contain cultural resources is similar to that of the corresponding link of the Applicant Proposed Route.

3.9.6.3.2.1.7 Region 7

3.9.6.3.2.1.7.1 Alternative Route 7-A

HVDC Alternative Route 7-A loops north up to approximately 10.5 miles from the Applicant Proposed Route and includes a separate crossing of the Mississippi River, approximately 6.75 miles upriver of the Applicant-proposed crossing. HVDC Alternative Route 7-A is longer (by 14.69 miles) than the corresponding link of the Applicant Proposed Route and traverses a greater section of Mississippi bottomland. Available Information shows a non-substantial difference in the number of inventoried archaeological sites and inventoried historic buildings and structures (Table 3.9-31). HVDC Alternative Route 7-A contains two NRHP- listed properties:

- Highway A-7 Bridges Historic District, Marked Tree vicinity, Poinsett County, Arkansas
- Nodena Site, Wilson vicinity, Mississippi County, Arkansas (NRHP/NHL)

HVDC Alternative Route 7-A intersects the Highway A-7 Bridges Historic District and is believed to pass at least 0.1 mile outside the NRHP/NHL boundaries of the Nodena Site. The HVDC transmission line would be visible from both properties. The line would span the Highway A-7 Bridge. Spanning a historic district could alter the landscape setting. The line would not cross or span the Nodena Site, so although this route would alter the landscape setting, it would not be expected to alter it substantially.

Table 3.9-31:
Frequency of Previously Inventoried Historic and Cultural Resources Per Linear Mile of HVDC Alternative Route in Region 7

		AR 7-A		AR 7-B		AR 7-C		AR 7-D	
	Region 7 APR	AR	APR Link 1	AR	APR Links 3, 4	AR	APR Links 3, 4, 5	AR	APR Links 4, 5
Length (miles)	42.83	43.24	28.55	8.61	8.38	23.83	13.20	6.54	6.39
Total Archaeological Sites (n)[1]	14	7	11	2	2	13	2	2	1
Total Aboveground Historic Properties (n)[1]	0	4	0	0	0	39	40	0	40
Archaeological Sites per Mile[2]	0.33	0.16	0.39	0.23	0.24	0.55	0.15	0.31	0.16
Historic Properties per Mile[2]	0.93	0.09	0.00	0.00	0.00	1.64	3.03	0.00	6.26

1 ROI for archaeological sites is a 1,000-foot corridor; ROI for aboveground historic properties and historic routes is a 1-mile corridor.
2 Density calculations are based on statewide records available in SHPO and state archaeologist offices.
Source: Clean Line (2013)

Comparison of land cover groups suggests that the alternative route traverses a somewhat more open landscape than the corresponding link of the Applicant Proposed Route (Table 3.9-32). Based on the available information, HVDC Alternative Route 7-A appears to have an overall higher potential for impacting cultural resources than the corresponding link of the Applicant Proposed Route.

Table 3.9-32:
Region 7 HVDC Transmission Line Alternative Routes—Percentage Comparison of Land Cover Groups for Assessment of Potential Project Effects on Historic and Cultural Resources

		AR 7-A		AR 7-B		AR 7-C		AR 7-D	
Land Cover Group[1]	Region 7 APR	AR	APR Link 1	AR	APR Links 3, 4	AR	APR Links 3, 4, 5	AR	APR Links 4, 5
A (Manipulated Terrain)	73.8%	88.9%	89.1%	49.6%	39.8%	66.3%	42.8%	53.5%	47.6%
B (Open Vegetation Patterns)	10.4%	0.4%	0.0%	32.4%	33.7%	21.9%	30.8%	32.4%	32.5%
C (Closed Vegetation Pattern)	13.7%	9.5%	7.5%	18.0%	26.5%	11.7%	26.4%	14.0%	19.9%
W (Water)	2.2%	1.2%	3.4%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
Total Acres	1,221	1,218	779	264	267	691	411	190	200

1 Land cover percentages and acreages based on a 200-foot representative ROW and including tensioning work sites, which typically extend outside the transmission line ROW. See Section 3.10 for discussion of source data quality and limitations. Percentages may not sum to 100 due to rounding error.
GIS Data Source: Jin et al. (2013)

3.9.6.3.2.1.7.2 Alternative Route 7-B

HVDC Alternative Route 7-B parallels the Applicant Proposed Route to the southwest for up to approximately 1.5 miles. HVDC Alternative Route 7-B is approximately the same length (longer by 0.23 mile) as the corresponding links of the Applicant Proposed Route and traverses similar terrain. The Applicant Proposed Route appears to cross more wooded terrain than the alternative (Table 3.9-32). Information on file with state and federal agencies shows an identical number of inventoried archaeological sites and no inventoried historic buildings and structures for the HVDC

Alternative Route 7-B as compared to the corresponding links of the Applicant Proposed Route (Table 3.9-31). Neither contains identified NRHP-listed or -eligible properties.

Given the small difference in length between the two routes and the available information, and the potential for HVDC Alternative Route 7-B to contain cultural resources is similar to that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.7.3 Alternative Route 7-C

HVDC Alternative Route 7-C includes a portion that parallels the Applicant Proposed Route and portion that loops south of the Applicant Proposed Route by up to 4.75 miles. HVDC Alternative Route 7-C is longer (by 10.63 miles) than the corresponding links of the Applicant Proposed Route, but it traverses similar terrain. The Applicant Proposed Route appears to cross more wooded terrain than the alternative (Table 3.9-32). Information on file with state and federal agencies shows that substantially more archaeological sites have been inventoried in the area of proposed HVDC Alternative Route 7-C as compared to the corresponding links of the Applicant Proposed Route, but that the number of inventoried historic buildings and structures is not substantially different (Table 3.9-31). Neither contains identified NRHP-listed or -eligible properties.

Given the difference in lengths between the two routes and the available information, the potential for HVDC Alternative Route 7-C to contain cultural resources appears to be somewhat greater overall than that of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.1.7.4 Alternative Route 7-D

HVDC Alternative Route 7-D loops to the north of the Applicant Proposed Route by approximately 2.7 miles. HVDC Alternative Route 7-D is approximately the same length (longer by 0.15 mile) as corresponding links of the Applicant Proposed Route and traverses similar terrain with similar land cover (Table 3.9-32). Information on file with state and federal agencies shows a non-substantial difference in the number of inventoried archaeological sites, but the number of inventoried historic buildings and structures in the Applicant Proposed Route is greater than the number for the alternative route (Table 3.9-31). Neither contains identified NRHP-listed or -eligible properties.

Given the small difference in length between the two routes and the available information, the potential for HVDC Alternative Route 7-D to contain cultural resources may be similar or somewhat less as compared to the estimated moderate potential of the corresponding links of the Applicant Proposed Route.

3.9.6.3.2.2 Operations and Maintenance Impacts

No impacts would result from the operations and maintenance activities on any of the HVDC alternative routes in Regions 1 through 7 (see Section 3.9.6.1.3).

3.9.6.3.2.3 Decommissioning Impacts

No impacts would result from decommissioning (see Section 3.9.6.1.3).

3.9.6.4 Best Management Practices

Additional BMPs are not recommended because DOE intends to develop a PA that will include assessment and resolution of effects, including avoidance, where practicable, and mitigation. As part of the PA, DOE intends to require the Applicant to develop and implement plans and activities (described in Section 3.9.6.1.1) as needed.

3.9.6.5 Unavoidable Adverse Impacts

DOE intends to develop a PA that will include assessment and resolution of effects, including avoidance, where practicable, and mitigation. As part of the PA, DOE intends to require the Applicant to develop and implement plans and activities (described in Section 3.9.6.1.1) as needed. Compliance with the PA and related plans would minimize unavoidable and adverse impacts to historic and cultural resources.

3.9.6.6 Irreversible and Irretrievable Commitment of Resources

Cultural resources are nonrenewable. Adverse direct effects to these resources would constitute an irreversible and irretrievable commitment of resources. DOE intends to develop a PA that will include assessment and resolution of effects, including avoidance, where practicable, and mitigation. As part of the PA, DOE intends to require the Applicant to develop and implement plans and activities (described in Section 3.9.6.1.1) as needed. Compliance with the PA and related plans and activities would minimize adverse direct effects to cultural resources. Any remaining adverse direct effects to cultural resources would represent an irreversible and irretrievable commitment of resources.

3.9.6.7 Relationship between Local Short-term Uses and Long-term Productivity

The impacts associated with short-term use of the environment for cultural resources would likely be minor as DOE intends to develop a PA that will include assessment and resolution of effects, including avoidance, where practicable, and mitigation. As part of the PA, DOE intends to require the Applicant to develop and implement plans and activities (described in Section 3.9.6.1.1) as needed.

3.9.6.8 Impacts from Connected Actions

3.9.6.8.1 Wind Energy Generation

The potential impacts common to all Project components (Section 3.9.6.1.1) and impacts common to construction, operations and maintenance, and decommissioning (Sections 3.9.6.1.2 and 3.9.6.1.3) apply to similar activities during wind energy generation.

The WDZs contain low densities of previously recorded prehistoric period and historic period archaeological sites (Table 3.9-12). The numbers of the previously recorded sites may reflect the lack of systematic archaeological survey within the WDZs and the region rather than the actual numbers and densities of prehistoric and historic period sites that are located within them. Most of the recorded sites have not been evaluated for their potential to be eligible to the NRHP.

Impacts to cultural resources that are potentially eligible to or listed in the NRHP could occur as a result of wind energy generation. The level of potential adverse impacts to cultural resources associated with wind energy generation would depend on the level of archaeological surveys conducted and the associated cultural resources BMPs and mitigation plans implemented by wind energy developers.

3.9.6.8.2 Optima Substation

Impacts to historic and cultural resources from construction of the future Optima Substation would be the same as described in Section 3.9.6.2.1 for the Oklahoma Converter Station and AC Interconnection Siting Areas and the common construction impacts described in Sections 3.9.6.1.1.

3.9.6.8.3 TVA Upgrades

Depending on the locations of the required TVA upgrades, ground-disturbing activities associated with upgrades to existing lines or construction of the new transmission line could affect archaeological sites, historic properties, and tribal resources. The potential for adverse effects to historic properties from upgrades to already existing TVA transmission lines and substations is low. Although TVA would route the new transmission line to minimize effects on historic properties, the potential for these effects from the construction of the proposed new transmission line is greater. Where avoidance of adverse effects to historic properties is not practicable, TVA would, in accordance with Section 106 of the NHPA, take appropriate measures to consult with consulting parties to attempt to resolve any adverse effects to historic properties.

3.9.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. While the No Action Alternative would result in no effects to cultural resources due to Project construction, operations and maintenance, and decommissioning, it is possible that some of the archaeological sites that may be located within the areas that would be affected by the Project would never be evaluated for their potential to be eligible for the NRHP and that some potentially NRHP-eligible and listed sites would suffer degradation due to ongoing neglect, lack of managed attention, and possibly vandalism.

Contents

Tables

Figures Presented in Appendix A

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3.10 Land Use

3.10.1 Regulatory Background

Land use laws and regulations relevant to the resources in the ROI are summarized in Table 3.10-1. Applicable permits are discussed in further detail in Appendix C. USDA programs are discussed further in Section 3.2.1.

Table 3.10-1:
Land Use Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Local		
City and county zoning ordinances, development regulations, and general or comprehensive plans under Arkansas Code Annotated Title 14, “Local Government”; Oklahoma Statutes Title 19, “Counties and County Officers,” (Section 863.1, “City and County Planning and Zoning,” through Section 863.29, “Exclusive Control by Commission”); Tennessee Statute Title 6, “Cities and Towns, Municipal Government Generally,” Chapter 54, “Municipal Powers Generally,” and Chapter 58, “Comprehensive Growth Plan”	Local governments (cities and counties) in Arkansas, Oklahoma, and Tennessee	May require permits for development in certain areas and determine setbacks and other requirements to protect the health, welfare, and safety of the general public.
State		
Oklahoma Administrative Code Title 385, Chapter 25	Oklahoma Commissioners of the Land Office	Lease and management of school trust lands in Oklahoma, Surface leases and other permits are designed to maximize income for the public school trust (CLO 2014).
Arkansas Code Annotated 15-20-502	Arkansas Natural Heritage Commission (ANHC)	The ANHC is granted the power to choose lands, waters, and interests to be included in the Natural Area System. The Natural Areas System preserves some of the most ecologically important areas in the state. The ANHC co-manages the Singer Forest Natural Area with the AGFC. Hunting is allowed within the Singer Forest Natural Area (ANHC 2014b). Natural areas are lands specifically managed to preserve and restore natural communities that have become rare (ANHC 2014a).
Amendment 35 to the Arkansas Constitution	Arkansas Game and Fish Commission	Approval from the AGFC would be required for construction of a transmission line through a WMA. The AGFC manages WMAs primarily for hunting (AGFC 2014).

Table 3.10-1:
Land Use Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Federal		
United States Code Title 33, Navigation and Navigable Waters Sec. 408 (33 USC § 408)	U.S. Army Corps of Engineers (USACE)	May grant permission for the alteration or permanent occupation of public works owned by the USACE.
Multiple-Use Sustained-Yield Act of 1960, as amended (16 USC § 528 *et seq.*) Ozark-St. Francis National Forests' Revised Land and Resource Management Plan (USFS 2005) 36 CFR Part 251, Subpart B—Special Uses	U.S. Forest Service (USFS)	The USFS manages the National Forests for a variety of public benefits, consistent with the Multiple-Use Sustained-Yield Act and the Ozark-St. Francis National Forests' Revised Land and Resources Management Plan. A Special Use Permit would be required for a transmission line through National Forest land.
The Agricultural Act of 2014 (H.R. 2642; Pub.L. 113–79)	U.S. Department of Agriculture (USDA) Natural Resources Conservation Service	Construction of the Project on land enrolled in conservation easement programs may require a compatible use authorization or easement modification (NRCS 2011).
National Wildlife Refuge System Administration Act (16 USC §§ 668dd-668ee) Appropriate Refuge Uses—Policy 603 FW 1 Compatibility—Policy 603 FW 2	U.S. Fish and Wildlife Service	This act allows easements or ROWs for powerlines so long as it is determined the powerline is compatible with the purposes for which an NWR was established. This is a two-step process, first to determine compatibility and second that it is an appropriate refuge use.
25 CFR Part 169	Arkansas Riverbed Authority, Bureau of Indian Affairs	A ROW grant or easement across land managed by the Authority may be issued pursuant to regulations governing transmission line ROWs over Indian lands.

3.10.2 Data Sources

Data from the NLCD (GIS Data Source: Jin et al. 2013) were used for the desktop land use analysis. The NLCD is a 16-class categorization of land cover based on satellite imagery and provides a broad description of land cover types. In addition to the NLCD information, existing datasets for existing infrastructure and airports and aerial imagery supplemented with aerial photointerpretation and field verification were used to determine the various land uses within the ROI. GIS sources include data and maps for ArcGIS (a system for working with maps and geographic information) from Environmental Systems Research Institute, Inc. (ESRI). Ground and aerial reconnaissance by the Applicant and comments received during stakeholder outreach and the DOE scoping process supplemented the desktop information. Structure data layers were created based on ESRI 2012 data (GIS Data Source: ESRI 2013) supplemented with aerial photointerpretation and field verification surveys conducted in 2012 and 2013. Structures were categorized as agricultural, church, commercial, industrial, residential, or school (GIS Data Source: Clean Line 2013a, 2013b; Tetra Tech 2014).

3.10.3 Region of Influence

For land use, the ROI for the Project and connected actions is the same as described Section 3.1.1.

3.10.4 Affected Environment

The majority of land in the ROI is privately owned, although some lands managed by state and federal agencies are found throughout the ROI. Table 3.10-2 summarizes the types of public land ownership by region. The largest single parcel of state land in all ROIs analyzed is the Schultz Wildlife Management Area (WMA) in the ROI of AC Collection System Route E-3 in Texas County, Oklahoma. The ROI with the largest percentage of public land is HVDC Alternative Route 4-B in Region 4, of which 12 percent is the Ozark National Forest. Figure 3.10-1 in Appendix A shows the public land ownership in the ROI.

Table 3.10-2:
Public Land Ownership in the ROI

Route[1]	Ownership	Acres	Percent of ROI
Region 1			
APR	State—Oklahoma School Lands	191	1.4
AR 1-A	State—Oklahoma School Lands	780	5.2
AR 1-B	State—Oklahoma School Lands	221	3.5
AR 1-C	State—Oklahoma School Lands	73	1.1
AR 1-D	State—Oklahoma School Lands	264	6.5
AC Collection System Routes			
E-1	Federal—USACE	558	1.4
	Federal—Optima National Wildlife Refuge	176	0.4
	State—Oklahoma School Lands	1,170	3.0
E-2	State—Oklahoma School Lands	509	1.0
E-3	State—Oklahoma School Lands	2,005	3.7
NE-1	State—Oklahoma School Lands	1,963	4.9
NE-2	State—Oklahoma School Lands	1,559	4.4
NW-1	State—Oklahoma School Lands	2,591	3.8
NW-2	State—Oklahoma School Lands	1,835	2.5
SE-1	State—Oklahoma School Lands	193	0.4
SE-3	State—Oklahoma School Lands	509	0.8
SW-2	State—Oklahoma School Lands	174	0.4
W-1	State—Oklahoma School Lands	191	0.7
Region 2			
Applicant Proposed Route	State—Oklahoma School Lands	456	3.5
AR 2-A	State—Oklahoma School Lands	123	1.8
Region 3			
Applicant Proposed Route	State—Oklahoma School Lands	430	2.2
	State—Oklahoma State University (Land Utilization Research Area)	267	1.3
	Federal—USACE (Weber Falls Lock and Dam and Reservoir Project)	12	0.1
AR 3-A	State—Oklahoma School Lands	98	2.1
	State—Oklahoma State University (Land Utilization Research Area)	64	1.4
	State—Oklahoma State University (Lake Carl Blackwell Project)	117	2.5
AR 3-B	State—Oklahoma School Lands	73	1.3
	State—Oklahoma State University (Land Utilization Research Area)	64	1.1
	State—Oklahoma State University (Lake Carl Blackwell Project)	117	2.0

Table 3.10-2:
Public Land Ownership in the ROI

Route[1]	Ownership	Acres	Percent of ROI
AR 3-C	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	5	0.03
	State—Oklahoma School Lands (Land Utilization Research Area)	129	0.9
AR 3-D	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	5	0.1
AR 3-E	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	5	0.4
Region 4			
Applicant Proposed Route	Federal—U.S. Forest Service (Ozark National Forest)	88	0.6
	Federal—USACE (Webbers Falls Lock, Dam, and Reservoir)	80	0.5
	State—AGFC (Frog Bayou WMA)	25	0.2
	State—AGFC (Ozark Lake WMA)	12	0.1
AR 4-B	Federal—US Forest Service	562	5.8
Region 5			
Region 5 PR	State—AGFC (Cherokee WMA)	379	2.8
Arkansas Converter Station Siting Area	State—AGFC (Cherokee WMA)	1,589	7.3
	State—AGFC (Rainey WMA)	485	2.2
Representative AR Interconnect	State—AGFC (Cherokee WMA)	81	0.8
	State—AGFC (Rainey WMA)	136	1.4
Region 6			
Applicant Proposed Route	State—Arkansas Game and Fish Commission (Singer Forest Natural Area easement)	11	0.2
	State—AGFC (St. Francis Sunken Lands WMA)	10	0.1
Region 7			
	City of Millington, TN (Aycock Park)	*	*

1 Only regions and alternatives with public land are included in the table. No electronic data were available for the municipally-owned Aycock Park in Region 7.

GIS Data Sources: USFWS (2014a), USFS (2014a, 2014b), AHDT (2006c), OSU (2003), TPWD (2012), TWRA (2007)

This section summarizes the existing land uses in the ROI. Land cover is discussed, followed by a qualitative description of the primary land uses found in the ROI including agriculture, transportation/utility, airports, commercial, industrial, public land and easements, parks and recreational/natural areas, residential, tribal land, and planned development. Figure 3.10-2 in Appendix A illustrates the structures and infrastructure in the ROI.

Table 3.10-3 summarizes the percentage of each USGS 2011 NLCD classification within the ROI (GIS Data Source: Jin et al. 2013). Multiple land uses can occur within each land cover type. Grassland/herbaceous is the dominant land cover, constituting almost half of the ROI. Cultivated crops account for approximately 26.9 percent of land cover in the ROI (Table 3.10-2). Figure 3.10-3 in Appendix A illustrates the land cover in the ROI.

Table 3.10-3:
Land Cover in the ROI

Land Cover	Acres	Percent
Barren Land (Rock/Sand/Clay)	549.4	0.1
Cultivated Crops	174,853.8	26.9
Deciduous Forest	37,227.4	5.7
Developed, High Intensity	42.4	0.0
Developed, Low Intensity	1,471.4	0.2
Developed, Medium Intensity	377.6	0.1
Developed, Open Space	28,951.3	4.4
Emergent Herbaceous Wetlands	545.0	0.1
Evergreen Forest	19,108.6	2.9
Grassland/Herbaceous	314,840.4	48.4
Mixed Forest	5,841.6	0.9
Open Water	1,661.5	0.3
Pasture/Hay	37,988.8	5.8
Shrub/Scrub	24,213.4	3.7
Woody Wetlands	2,997.4	0.5
Total	650,670.0	100.0

Source: Jin et al. (2013)

3.10.4.1 Agriculture

Agriculture is the predominant land use in the ROI. In Region 1 (including the AC Collection System Routes) and Region 2, rangeland/pasture is the primary type of agriculture, whereas cultivated crops are more prevalent in Regions 6 and 7 (Figure 3.10-3 in Appendix A). Agricultural structures found in the ROI include concentrated animal feeding operations, barns, and silos, which are distributed throughout the ROI. Center-pivot and mechanically irrigated agricultural fields are predominantly located in western and central Oklahoma and northern Texas. Center-pivot agricultural fields are also dispersed throughout eastern Arkansas. Precision-graded, flood-irrigated agricultural fields, such as those used for rice farming, are predominantly located west and east of the Mississippi River in Arkansas and Tennessee. Agriculture is discussed in greater detail in Section 3.2.

3.10.4.2 Transportation/Utility

Existing infrastructure in the ROI includes roadways, airports, heliports, and airstrips, electrical transmission lines, oil and gas pipelines, railroads, and communication towers. Fifty-two airports, heliports, and airstrips are located throughout the ROI (Figure 3.10-2 in Appendix A). Communication towers are illustrated on Figure 3.10-4 in Appendix A. Subsurface utilities, such as electrical distribution lines, water lines, cables, and telephone lines, are also located throughout the ROI. The linear components of the Project would be located parallel to existing infrastructure such as transmission lines, oil and gas pipelines, and roadways to the extent practicable

The ROI crosses reservoirs that are managed by the USACE along the McClellan-Kerr Arkansas River Navigation System, which provides for barge navigation on the Arkansas River and some of its tributaries. The USACE maintains the locks and navigation system of the Robert S. Kerr Lake and Webbers Falls Reservoir in Regions 3 and 4.

3.10.4.3 Commercial

Commercial land uses are scattered throughout the ROI, but they are generally sparse, given the rural character of the majority of the ROI. Commercial land uses are generally located at intersection of roadways or along major roadways such as Highway 77 near Stillwater, Oklahoma, in Region 3 and in Millington, Tennessee, in Region 7.

3.10.4.4 Industrial

The primary industrial land use in the ROI is oil and gas development and related industries. Oil and gas wells and their appurtenant facilities are very common throughout the ROI in Regions 4 and 5. Three large aboveground compressor stations associated with oil and gas production and distribution are found in the ROI: within the Applicant Proposed Route in Region 5; within the HVDC Alternative Route 1-B in Region 2, and within HVDC Alternative Route 5-B in Region 5. Additionally, there is a large oil storage facility south of Cushing, Oklahoma, crossed by the ROI in Region 3.

3.10.4.5 Public Land and Easements

Publicly owned or managed resources in the ROI include the Ozark National Forest, school trust lands (primarily leased for either oil and gas development or agriculture), WMAs, a state natural area, land and a lake owned by Oklahoma State University, and a NWR, and wetland easements held by the NRCS (NRCS 2014). Additionally, the Arkansas River south of Webbers Falls Lock and Dam 16 in Region 4 is managed by the USACE and is located in the Applicant Proposed Route (Figure 3.10-1 in Appendix A). There is a scenic overlook near the lock, and Webbers Falls Reservoir is publicly accessible for recreational uses such as boating and fishing. These public lands are discussed in further detail by region in Section 3.10.5.

3.10.4.6 Parks and Recreational/Natural Areas

Recreational resources located in the ROI include WMAs, national forest lands, and local parks. There are no federal or state parks in the ROI. Although there are some municipal parks located near the ROI, they are not very common given the rural character of the majority of the ROI.

Recreational areas and uses are described in greater detail in Section 3.12.

3.10.4.7 Residential

The ROI is predominantly rural and the primary type of residence found in the ROI consists of single-family residences on large lots, generally surrounded by agricultural land uses. These residences are widely dispersed throughout the ROI. Higher density residential developments are found in and around cities and towns. The number of residences found within the ROI by region and alternate route is discussed in Section 3.10.5.

3.10.4.8 Tribal Land

The Arkansas Riverbed Authority manages the tribal interests of two parcels on the west and east bank of the Arkansas River, south of Webbers Falls Lock and Dam 16 in the ROI in Region 3 and Region 4. Any crossings of tribal lands, as defined by 25 CFR 169.1(d), by the HVDC route and its alternatives would be limited to a width of 400 feet (200 feet either side of the centerline) per 25 CFR 169.27(d). Title 25 CFR Part 169 is the regulation governing ROWs over Indian Lands.

3.10.5 Regional Description

This section summarizes NLCD land cover data for each component of the Project by region and discusses land uses in the ROI for each region in more detail.

3.10.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route and HVDC Alternative Routes I-A through I-D as well as the Oklahoma converter station and AC interconnect and AC collection system routes. The predominant land cover in the ROI for all Project components and alternatives is grassland/herbaceous (Table 3.10-4; Figure 3.10-3 in Appendix A). In the 2-mile-wide ROI for the AC collection routes, grassland/herbaceous is also the primary land cover (Table 3.10-5; Figure 3.10-3 in Appendix A).

AC Collection System Routes NE-1 and SE-2 consist primarily of cultivated crops. Approximately 30 percent of AC Collection System Route E-2 consists of cultivated crops; NE-2, NW-2, NW-1, SE-1, SE-3, and W-1 also have substantial percentages of cultivated crops.

Oklahoma school trust lands are present in the ROI (Figure 3.10-1 in Appendix A). The Optima NWR and Optima Lake (managed by USACE) are located in the ROI of AC Collection System Route E-1. Recreational opportunities at this refuge are discussed in Section 3.12.

Communities in the ROI include Goodwell and Hardesty, Oklahoma, and Waka, Texas (Figure 3.10-2 in Appendix A). All of these communities are small agricultural towns along major roadways with a central residential area and limited commercial and industrial development.

Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Three public airports are located in the ROI; airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and the HVDC alternative routes are 105 agricultural structures, 47 industrial structures, 32 residential structures, 3 commercial structures, 3 abandoned structures, and 1 church. Within the ROI for the Oklahoma Converter Station Siting Area and the representative AC interconnect are 4 industrial structures. Within the 13 AC collection routes are 1,528 agricultural structures, 709 industrial structures, 451 residential structures, 26 commercial structures, 7 abandoned structures, 1 church, and 2 schools.

3.10.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A through 2-B. In Region 2, the primary land cover for the Applicant Proposed Route is grassland/herbaceous (Figure 3.10-3 in Appendix A; 49 percent), followed by cultivated crops (33 percent). Approximately 8 percent of the Applicant Proposed Route ROI is evergreen forest, and almost 6 percent is developed open space. The ROI for HVDC Alternative Route 2-A is primarily composed of grassland/herbaceous (59.8 percent), followed by cultivated crops (23.4 percent) and evergreen forest (6.4percent). In contrast, 59.6 percent of the ROI for HVDC Alternative Route 2-B is composed of cultivated crops (Table 3.10-6).

State-managed lands in the ROI in Region 2 are limited to one parcel of Oklahoma school trust lands in the Applicant Proposed Route and also in HVDC Alternative Route 2-A. Major County WMA is adjacent to the ROI for HVDC Alternative Route 2-A (Figure 3.10-1 in Appendix A).

There are no communities in the Region 2 ROI. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. One private airport is located in the ROI (Figure 3.10-2 in Appendix A); airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and HVDC alternative routes are 70 industrial structures, 56 agricultural structures, and 33 residential structures.

3.10.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. In Region 3, the land cover in the ROI of the Applicant Proposed Route is more varied than in Regions 1 and 2. It primarily consists of grassland/herbaceous (Figure 3.10-3 in Appendix A; 34.3 percent), deciduous forest (27.2 percent), and pasture/hay (23.4 percent). The land cover in the ROI for HVDC Alternative Routes 3-B and 3-C is similar. In contrast, half of the ROI for HVDC Alternative Route 3-A has grassland/herbaceous land cover, and approximately half of the land cover in the ROI for HVDC Alternative Routes 3-D and 3-E is pasture/hay (Table 3.10-7).

Federal land in the Region 3 ROI is the Webbers Falls Lock, Dam, and Reservoir. Webbers Falls Reservoir is a 10,900-acre lake on the Arkansas River near Gore, Oklahoma (Figure 3.10-1 in Appendix A). The USACE manages the dam and reservoir, which provides recreational opportunities such as boating and fishing. As discussed in Section 3.10.4.8, the Arkansas Riverbed Authority manages the tribal interests of two parcels on the west and east bank of the Arkansas River, south of Webbers Falls Lock and Dam 16. Any crossings of tribal lands, as defined by 25 CFR 169.1(d), by the HVDC route and its alternatives would be limited to a width of 400 feet (200 feet either side of the centerline) per 25 CFR 169.27(d). State lands in the Region 3 ROI include Oklahoma State University Land Utilization Research Area and Lake Carl Blackwell and school trust lands (Figure 3.10-1 in Appendix A).

Dams constructed by the USDA-NRCS are located in and near the ROI along waterways. These dams were constructed primarily for flood prevention, but also provide irrigation and recreational opportunities. Operations and maintenance of these dams is the responsibility of the local sponsor, typically a drainage district in Oklahoma and a levee district in Arkansas.

Near the Cimarron River, the Applicant Proposed Route travels by oil storage tanks near the city of Cushing and the outer limits of the town of Summit (Figure 3.10-2 in Appendix A). HVDC Alternative Route 3-B traverses a rural commercial/industrial area south of Stillwater, Oklahoma. HVDC Alternative Route 3-C is located along the eastern edge of the city of Perkins. The ROI includes primarily commercial and industrial areas on the outskirts of these communities.

Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Four public airports, four private airports, one public heliport, and three private heliports are located in the ROI; airports and heliports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and the HVDC alternative routes are 314 residential structures, 181 agricultural structures, 32 industrial structures, 10 commercial structures, and 6 abandoned structures.

3.10.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation in Link 3. Link 3 crosses Lee Creek Reservoir in Sequoyah County, Oklahoma and Crawford County, Arkansas, at the upstream end of the reservoir in a buffer zone managed by the city of Fort Smith (Figure 3.10-2 in Appendix A). The Lee Creek Variation is a 3.4-mile variation of the Applicant Proposed Route that was created in response to scoping comments from the city of Fort Smith, Arkansas, expressing concern about the proximity of the proposed route to the Lee Creek Dam and Reservoir.

Table 3.10-4:
Land Cover in the Region 1 ROI

Land Cover	Applicant Proposed Route		AR 1-A		AR 1-B		AR-1C		AR-1D		Oklahoma Converter Station		OK Interconnect	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	2.3	0.0	4.9	0.0	2.1	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	3,874.1	27.6	1,538.2	10.3	707.1	11.2	855.1	13.5	564.4	13.8	0.0	0.0	75.6	8.7
Deciduous Forest	2.2	0.0	15.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	16.8	0.1	7.2	0.0	9.7	0.2	12.6	0.2	5.0	0.1	0.0	0.0	0.0	0.0
Developed, Medium Intensity	4.6	0.0	11.1	0.1	0.1	0.0	0.1	0.0	8.5	0.2	0.0	0.0	0.0	0.0
Developed, Open Space	528.4	3.8	922.1	6.2	407.4	6.5	350.7	5.5	267.4	6.6	25.9	4.1	26.8	3.1
Evergreen Forest	2.2	0.0	16.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	8,751.3	62.4	11,571.2	77.5	4,625.5	73.3	4,571.4	72.3	2,958.8	72.9	593.3	94.8	720.2	82.7
Open Water	58.2	0.4	21.8	0.1	0.8	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Shrub/Scrub	758.8	5.4	772.1	5.2	557.7	8.8	529.9	8.4	236.9	5.8	6.7	1.1	48.6	5.6
Woody Wetlands	29.8	0.2	47.5	0.3	0.0	0.0	3.9	0.1	16.3	0.4	0.0	0.0	0.0	0.0
Total	14,027.9	100.0	14,929.0	100.0	6,310.4	100	6324.0	100.0	4,059.3	100.0	625.9	100.0	871.2	100.0

Source: Jin et al. (2013)

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Table 3.10-5:
Land Cover by AC Collection System Route

Route		Open Water	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Barren Land (Rock/Sand/ Clay)	Deciduous Forest	Shrub/ Scrub	Grassland/ Herbaceous	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands	Total
E1	Acres	0.0	2,462.7	84.1	6.2	0.0	22.2	0.0	2,547.7	31,464.8	2,651.3	100.9	0.0	39,339.9
	Percent	0.0	6.3	0.2	0.0	0.0	0.1	0.0	6.5	80.0	6.7	0.3	0.0	100.0
E2	Acres	9.8	2,384.0	20.3	1.1	0.0	13.7	0.0	3,880.7	31,000.1	15,614.9	49.4	0.0	52,977.8
	Percent	0.0	4.5	0.0	0.0	0.0	0.0	0.0	7.3	58.5	29.5	0.1	0.0	100.0
E3	Acres	18.7	2,216.6	31.4	0.0	0.0	31.3	0.0	4,052.0	39,227.5	7,912.7	25.7	0.0	53,515.0
	Percent	0.0	4.1	0.1	0.0	0.0	0.1	0.0	7.6	73.3	14.8	0.0	0.0	100.0
NE1	Acres	71.4	2,460.0	191.8	34.9	3.1	45.1	1.8	1,885.3	17,464.3	18,172.8	15.9	12.9	40,364.4
	Percent	0.2	6.1	0.5	0.1	0.0	0.1	0.0	4.7	43.3	45.0	0.1	0.0	100.0
NE-2	Acres	56.3	1,718.8	28.7	2.7	0.0	74.6	1.6	1,795.3	22,267.0	9,215.4	38.9	8.7	35,208.0
	Percent	0.2	4.9	0.1	0.0	0.0	0.2	0.0	5.1	63.2	26.2	0.1	0.0	100.0
NW-1	Acres	9.1	3,788.5	124.8	6.7	0.0	32.9	0.0	1,409.8	51,263.7	11,524.7	1.6	0.0	68,161.7
	Percent	0.0	5.6	0.2	0.0	0.0	0.0	0.0	2.1	75.2	16.9	0.0	0.0	100.0
NW-2	Acres	99.8	3,629.2	120.2	33.3	3.1	85.8	0.0	1,896.2	37,915.4	30,061.2	25.9	26.5	73,896.0
	Percent	0.1	4.9	0.2	0.0	0.0	0.1	0.0	2.6	51.3	40.7	0.0	0.0	100.0
SE-1	Acres	38.6	2,312.4	19.6	1.1	0.0	12.2	0.0	3,304.9	28,465.8	18,582.2	302.9	0.0	53,088.4
	Percent	0.1	4.4	0.0	0.0	0.0	0.0	0.0	6.2	53.6	35.0	0.6	0.0	100.0
SE-2	Acres	10.2	797.2	59.7	9.7	0.0	4.4	0.0	476.8	8,525.0	9,040.0	4.1	0.7	18,927.8
	Percent	0.1	4.2	0.3	0.1	0.0	0.0	0.0	2.5	45.0	47.8	0.0	0.0	100.0%
SE-3	Acres	59.8	2,564.4	53.7	1.1	0.0	15.2	0.0	5,127.3	32,703.0	23,887.7	60.3	44.2	64,516.7
	Percent	0.1	4.0	0.1	0.0	0.0	0.0	0.0	7.9	50.7	37.0	0.1	0.1	100.0
SW-1	Acres	1.1	635.6	69.2	3.5	0.0	6.9	0.0	613.6	16,220.4	1,586.5	4.1	0.7	19,105.0
	Percent	0.0	3.3	0.4	0.0	0.0	0.0	0.0	3.2	84.7	8.3	0.0	0.0	100.0
SW-2	Acres	24.0	1,897.4	36.7	2.4	0.0	45.4	0.0	773.5	41,661.6	4,926.2	0.0	0.0	49,367.2
	Percent	0.0	3.8	0.1	0.0	0.0	0.1	0.0	1.6	84.4	10.2	0.0	0.0	100.0
W-1	Acres	13.1	1,397.7	78.6	59.2	0.0	20.8	0.0	486.8	21,047.9	5,401.8	0.0	0.0	28,505.8
	Percent	0.0	4.9	0.3	0.2	0.0	0.1	0.0	1.7	73.8	18.9	0.0	0.0	100.0

Source: Jin et al. (2013)

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Table 3.10-6:
Land Cover in the Region 2 ROI

Land Cover	Applicant Proposed Route		AR 2-A		AR 2-B	
	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	0.0	0.0	4.0	0.1	1.6	0.0
Cultivated Crops	4,241.3	33.0	1,622.7	23.4	2,148.2	59.6
Deciduous Forest	130.8	1.0	267.3	3.9	73.3	2.0
Developed, Low Intensity	69.1	0.5	44.6	0.6	4.9	0.1
Developed, Medium Intensity	14.2	0.1	13.5	0.2	0.0	0.0
Developed, Open Space	730.9	5.7	284.5	4.1	134.0	3.7
Evergreen Forest	1,058.3	8.2	440.9	6.4	13.7	0.4
Grassland/Herbaceous	6,296.8	49.0	4,153.5	59.8	1,194.3	33.2
Mixed Forest	197.7	1.5	0.0	0.0	0.0	0.0
Open Water	39.3	0.3	23.1	0.3	31.7	0.9
Pasture/Hay	15.1	0.1	18.8	0.3	0.0	0.0
Shrub/Scrub	54.6	0.4	69.1	1.0	0.0	0.0
Total	12,847.3	100.0	6,942.1	100.0	3,601.7	100.0

Source: Jin et al. (2013)

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Table 3.10-7:
Land Cover in the Region 3 ROI

Land Cover	Applicant Proposed Route		AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	18.8	0.1	0.0	0.0	4.0	0.1	6.2	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	1,629.6	8.3	833.8	18.2	964.5	16.6	645.2	4.4	279.2	5.8	0.0	0.0
Deciduous Forest	5,344.8	27.2	939.0	20.5	1,090.5	18.8	4,303.1	29.1	900.2	18.8	355.9	33.3
Developed, High Intensity	0.6	0.0	0.0	0.0	13.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	30.0	0.2	0.0	0.0	9.2	0.2	22.4	0.2	10.0	0.2	3.8	0.4
Developed, Medium Intensity	8.1	0.0	2.5	0.1	10.6	0.2	9.8	0.1	7.6	0.2	3.8	0.4
Developed, Open Space	910.8	4.6	220.1	4.8	251.5	4.3	448.7	3.0	170	3.6	47.3	4.4
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	8.4	0.3	0.0	0.0	0.0	0.0
Evergreen Forest	275.2	1.4	29.9	0.7	46.7	0.8	47.3	0.3	10.0	0.2	0.0	0.0
Grassland/Herbaceous	6,725.4	34.3	2,498.2	54.6	3,238.0	55.8	5,286.5	35.8	957.0	20.0	115.2	10.8
Open Water	84.2	0.4	33.3	0.7	39.9	0.7	71.2	0.5	15.9	0.3	7.4	0.7
Pasture/Hay	4,603.0	23.4	20.7	0.5	139.0	2.4	3,915.3	26.5	2,441.7	51.0	533.8	50.0
Shrub/Scrub	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0
Total	19,634.0	100.0	4577.6	100.0	5,807.3	100.0	14,767.0	100.0	4,790.1	100.0%	1,067.2	100.0

Source: Jin et al. (2013)

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Land cover in the ROI of the Applicant Proposed Route is predominantly pasture/hay (Figure 3.10-3 in Appendix A; 45.8 percent) and deciduous forest (26.2 percent). There is also a higher percentage of evergreen forest (13.4 percent) than in the western portions (Regions 1, 2, and 3) of the Project. The ROI of HVDC Alternative Routes 4-D and 4-E have similar land cover distributions; in contrast, the ROI for HVDC Alternative Routes 4-A and 4-B is predominantly deciduous forest (Table 3.10-8). The Lee Creek Variation is dominated by forest land (92.6 percent of land cover).

Federally managed lands in the ROI include the USACE-managed Webbers Falls Lock, Dam, and Reservoir, the Ozark National Forest, and approximately 38 acres of land enrolled in the WRP. As discussed in Section 3.10.4.8, the Arkansas Riverbed Authority manages the tribal interests of two parcels on the west and east bank of the Arkansas River, south of Webbers Falls Lock and Dam 16. Any crossings of tribal lands, as defined by 25 CFR 169.1(d), by the HVDC route and its alternatives would be limited to a width of 400 feet (200 feet either side of the centerline) per 25 CFR 169.27(d). State lands in the ROI in Region 4 include Ozark Lake WMA and Frog Bayou WMA.

The ROI for HVDC Alternative Route 4-B and a small portion of the ROI for the Applicant Proposed Route cross portions of the Ozark National Forest and Ozark National Forest WMA (Figure 3.10-1 in Appendix A). These portions are owned by both the federal government (as managed by the USFS) and private citizens. The privately held land within the National Forest lies within the boundary of land approved for acquisition by the federal government for incorporation into the Forest. According to the Revised Land and Resource Management Plan for the Ozark and St. Francis National Forests (USFS 2005), the two forests are managed for multiple uses, including recreation, timber, grazing, minerals extraction, and wildlife habitat. The Arkansas Game and Fish Commission (AGFC) manages hunting in the WMA.

The ROI does not traverse any communities. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Two public airports, two private airports, two public heliports, and one private heliport are located in the ROI (Figure 3.10-2 in Appendix A); airports and heliports are discussed further in Section 3.16. USDA dams are present along waterways such as Sallisaw Creek (Figure 3.10-2 in Appendix A). Within the ROI for the HVDC Applicant Proposed Route, the Lee Creek Variation, and the HVDC alternative routes are 493 residential structures, 337 agricultural structures, 10 commercial structures, 7 industrial structures, 3 abandoned structures, and 2 churches.

3.10.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. The primary land cover categories in the Applicant Proposed Route in Region 5 is pasture/hay (29.1 percent), deciduous forest (28.9 percent), and evergreen forest (16.0 percent). Mixed forest makes up a much higher percentage of the Applicant Proposed Route in this region than any other at 10.3 percent (Table 3.10-9; Figure 3.10-3 in Appendix A). Evergreen forest is the primary land cover in the ROI of HVDC Alternative Route 5-A, deciduous forest is the primary land cover in the ROI of HVDC Alternative Routes 5-C and 5-D, and pasture/hay is the primary land cover in the ROI of HVDC Alternative Routes 5-B, 5-E, and 5-F. The land cover in the ROI of the Arkansas Converter Station Alternative Siting Area is evergreen forest (36.1 percent), deciduous forest (24.8 percent), and pasture/hay (20.9 percent).

There are no federal lands in the ROI in Region 5. State-managed lands in the ROI in Region 5 include the state-owned Rainey WMA (in the ROI for the Arkansas converter station) and the state-leased Cherokee WMA (Figure 3.10-1 in Appendix A).

No towns or cities with municipal boundaries are located within the ROI. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Seven private airports are located in the ROI (Figure 3.10-2 in Appendix A); airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route, the HVDC alternative routes, the Arkansas Converter Station Siting Area, and the associated AC Interconnection Siting Area there are 449 residential structures, 253 agricultural structures, 52 industrial structures, 11 abandoned structures, 11 commercial structures, and 4 churches.

3.10.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Land cover in the ROI in Region 6 is more uniform and consists primarily of cultivated crops; this land cover category accounts for approximately 78 percent of the Applicant Proposed Route and at least 73 percent of each HVDC alternative route (Figure 3.10-3 in Appendix A; Table 3.10-10). Open water and woody wetlands are also more prevalent than in western portions of the ROI for the Project, at approximately 4 percent and 6 percent, respectively, of the Applicant Proposed Route. Open water and woody wetlands comprise 2 to 5 percent and 4 to 14 percent, respectively, of the HVDC Alternative Routes in Region 6.

A natural/recreational area found in the ROI is the Singer Forest Natural Area easement, within the St. Francis Sunken Lands WMA (Applicant Proposed Route) (Figure 3.10-1 in Appendix A). Singer Forest Natural Area was Arkansas's first natural area and was donated to ANHC by the Singer Company in 1973 (ANHC 2010a). The Singer Forest Natural Area is currently owned by AGFC but co-managed by both agencies. Although hunting is permitting, travel within the natural area is limited to foot traffic (ANHC 2010b). Recreational opportunities are discussed in Section 3.12.

There are no communities that have towns or cities with municipal boundaries located within the ROI. Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. One public airport and 16 private airports are located in the ROI (Figure 3.10-2 in Appendix A); airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route and the HVDC alternative routes are 48 residential structures and 30 agricultural structures.

3.10.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D, as well as the Tennessee Converter Station Siting Area. Similar to the ROI in Region 6, the primary land cover in the Applicant Proposed Route in Region 7 is cultivated crops, at approximately 69.1 percent (Figure 3.10-3 in Appendix A; Table 3.10-11). Cultivated crops are also the primary land cover in the ROI for the four HVDC alternative routes in Region 7 and the Tennessee Converter Station Siting Area. Pasture/hay accounts for at least 15 percent of the ROI for HVDC Alternative Routes 7-B, 7-C, and 7-D and approximately 26.5 percent of the ROI for the Tennessee Converter Station Siting Area.

Public lands in the ROI in Region 7 include city-owned Aycock Park in the city of Millington, Tennessee (Figure 3.10-1 in Appendix A).

Table 3.10-8:
Land Cover in the Region 4 ROI

Land Cover	Applicant Proposed Route		Lee Creek Variation		AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	7.5	0.0	0.0	0.0	0.0	0.0	5.8	0.1	0.0	0.0	0.0	0.0	7.1	0.2
Cultivated Crops	332.6	2.2	0.0	0.0	7.5	0.1	7.5	0.1	0.0	0.0	7.5	0.2	12.1	0.3
Deciduous Forest	4014.6	26.2	327.3	78.4	3,087.9	43.4	4,280.8	44.9	172.6	40.8	845.8	27.4	626.9	14.1
Developed, Low Intensity	113.1	0.7	0.0	0.0	22.1	0.3	34.4	0.4	4	0.9	17.3	0.6	31.2	0.7
Developed, Medium Intensity	3.8	0.0	0.0	0.0	5.5	0.1	4.5	0.0	0.0	0.0	3.4	0.1	3.2	0.1
Developed, Open Space	447.7	2.9	0.0	0.0	180.5	2.5	229.7	2.4	9.2	2.2	89.9	2.9	193.9	4.3
Emergent Herbaceous Wetlands	22.1	0.1	0.0	0.0	8.8	0.1	6.8	0.1	0.0	0.0	6.8	0.2	0.0	0.0
Evergreen Forest	2,058.1	13.4	41.8	10.0	378.9	5.3	1,270.1	13.3	66.0	15.6	359.3	11.6	1,128.1	25.3
Grassland/Herbaceous	373.8	2.4	24.1	5.8	624.2	8.8	673.4	7.1	21.8	5.1	94.3	3.1	41.9	0.9
Mixed Forest	570.8	3.7	17.6	4.2	227.6	3.2	461.5	4.8	42.6	10.1	140.2	4.5	270.7	6.1
Open Water	65.9	0.4	2.9	0.7	17.9	0.3	22.3	0.0	0.0	0.0	8.0	0.3	5.7	0.1
Pasture/Hay	7,014.0	45.8	0.0	0.0	2,441.7	34.3	2,399.8	25.2	107.3	25.3	1,501.2	48.6	1,922.6	43.1
Shrub/Scrub	174.2	1.1	2.9	0.7	84.2	1.2	121.9	1.3	0.0	0.0	8.1	0.3	158.9	3.6
Woody Wetlands	114.6	0.7	1.0	0.2	24.1	0.3	22.6	0.2	0.0	0.0	7.5	0.2	56.8	1.3
Total	15,312.9	100.0	417.5	100.0	6,992	100.0	9,541.1	100.0	423.5	100.0	3,089.3	100.0	4,459.1	100.0

Source: Jin et al. (2013)

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Table 3.10-9:
Land Cover in the Region 5 ROI

Land Cover	Applicant Proposed Route		AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F		AR Converter Station Alternative Siting Area		AR Interconnect	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	76.8	0.6	2.4	0.2	23.3	0.3	8.7	0.8	0.0	0.1	12.4	0.3	9.5	0.3	50.8	0.2	5.8	0.1
Cultivated Crops	765.1	5.6	0.0	0.0	234.8	2.7	3.6	0.3	464.8	17.6	200.8	4.5	161.5	5.9	19.6	0.1	16.9	0.2
Deciduous Forest	3,949.0	28.9	421.2	27.3	2,113.7	24.5	469.0	41.5	1,214.7	45.9	1,128.6	25.5	733.2	26.8	5,425.4	24.8	1,823.9	19.0
Developed, High Intensity	14.9	0.1	0.0	0.0	4.4	0.1	0.0	0.0	2.0	0.1	1.5	0.0	1.5	0.1	2.2	0.0	1.1	0.0
Developed, Low Intensity	62.7	0.5	1.5	0.1	59.1	0.7	5.4	0.5	12.7	0.5	32.7	0.7	13.8	0.5	55.6	0.3	47.6	0.5
Developed, Medium Intensity	61.5	0.4	0.0	0.0	26.6	0.3	7.3	0.6	6.0	0.2	12.9	0.3	7.0	0.3	23.0	0.1	8.5	0.1
Developed, Open Space	349.3	2.6	50.9	3.3	192.0	2.2	19.0	1.7	116.7	4.4	85.3	1.9	61.8	2.3	576.0	2.6	304.6	3.2
Emergent Herbaceous Wetlands	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	68.1	0.7
Evergreen Forest	2,192.3	16.0	616.2	39.9	1,093.4	12.7	26.4	2.3	103.1	3.9	454.8	10.3	362.3	13.2	7,894.6	36.1	2,648.3	27.5
Grassland/Herbaceous	415.5	3.0	70.3	4.6	386.4	4.5	58.0	5.1	110.0	4.2	214.5	4.8	86.9	3.2	701.2	3.2	213.5	2.2
Mixed Forest	1,407.1	10.3	95.3	6.2	525.3	6.1	163.2	14.4	291.1	11.0	285	6.4	213.5	7.8	1,850.7	8.5	496.4	5.2
Open Water	51.5	0.4	0.8	0.1	4.9	0.1	4.8	0.4	33.3	1.3	0.7	0.0	0.7	0.0	82.1	0.4	52.7	0.5
Pasture/Hay	3,979.7	29.1	269.7	17.5	3,864.4	44.8	363.3	32.1	217.0	8.2	1,980.5	44.8	1,074.3	39.3	4,563.4	20.9	3,116.8	32.4
Shrub/Scrub	211.1	1.5	13.2	0.9	69.5	0.8	0.0	0.0	1.4	0.1	0.0	0.0	0.0	0.0	499.2	2.3	335.5	3.5
Woody Wetlands	145.7	1.1	2.3	0.1	29.9	0.3	2.6	0.2	72.4	2.7	13.0	0.3	8.9	0.3	115.0	0.5	484.2	5.0
Total	13,648.0	100.0	1,543.9	100.0	8,627.7	100.0	1,131.2	100.0	2,645.5	100.0	4,422.6	100.0	2,734.9	100.0	21,862.5	100.0	9,623.7	100.0

1 Source: Jin et al. (2013)

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Table 3.10-10:
Land Cover in the Region 6 ROI

Land Cover	Applicant Proposed Route		AR 6-A		AR 6-B		AR 6-C		AR 6-D	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	3.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	5,144.8	77.8	1,612.5	82.0	1,361.8	79.2	2,075.7	73.2	899.1	79.7
Deciduous Forest	443.8	6.7	0.4	0.0	4.2	0.2	221.3	7.8	5.2	0.5
Developed, Low Intensity	8.6	0.1	2.5	0.1	10.2	0.6	3.1	0.1	0.0	0.0
Developed, Medium Intensity	7.3	0.1	0.0	0.0	2.4	0.1	2.1	0.1	0.0	0.0
Developed, Open Space	305.8	4.6	65.4	3.3	72.7	4.2	182.4	6.4	52.2	4.6
Emergent Herbaceous Wetlands	3.1	0.0	0.0	0.0	2.9	0.2	0.0	0.0	1.1	0.0
Grassland/Herbaceous	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Forest	29.2	0.4	0.0	0.0	0.0	0.0	50.8	1.8	62.0	5.5
Open Water	265.8	4.0	106.3	5.4	31.9	1.9	90.7	3.2	22.9	2.0
Pasture/Hay	16.7	0.3	0.0	0.0	0.0	0.0	93.5	3.3	0.0	0.0
Woody Wetlands	378.0	5.7	179.8	9.1	232.7	13.5	114.9	4.1	86.0	7.6
Total	6,608.7	100.0	1,966.9	100.0	1,718.9	100.0	2,834.4	100.0	1,128.6	100.0

Source: Jin et al. (2013)

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Table 3.10-11:
Land Cover in the Region 7 ROI

Land Cover	Applicant Proposed Route		AR 7-A		AR 7-B		AR 7-C		AR 7-D		Tennessee Converter Station Siting Area	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Barren Land (Rock/Sand/Clay)	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	3,588.4	69.1	4,434.2	84.6	451.2	42.9	1,687.5	58.5	388.1	48.5	398.5	53.6
Deciduous Forest	393.1	7.6	1.8	0.0	187.9	17.9	271.1	9.4	80.1	10.0	79.4	10.7
Developed, Low Intensity	40.0	0.8	27.0	0.5	3.1	0.3	54.6	1.9	9.7	1.2	6.5	0.9
Developed, Medium Intensity	3.2	0.1	11.8	0.0	0.0	0.0	5.4	0.2	0.0	0.0	0.0	0.0
Developed, Open Space	254.2	4.9	344.3	6.8	38.4	3.7	83.8	2.9	30.9	3.9	17.4	2.3
Emergent Herbaceous Wetlands	7.3	0.1	10.0	0.2	0.0	0.0	15.7	0.5	3.0	0.4	0.0	0.0
Evergreen Forest	4.6	0.1	0.0	0.0	2.0	0.2	6.1	0.2	1.0	0.1	1.3	0.2
Grassland/Herbaceous	9.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Mixed Forest	3.7	0.1	0.0	0.0	0.0	0.0	1.8	0.1	1.6	0.2	1.1	0.1
Open Water	114.3	2.2	98.7	1.9	0.4	0.0	1.3	0.0	30.9	3.9	0.0	0.0
Pasture/Hay	182.5	3.5	5.9	0.1	210.5	20.0	430.1	14.9	138.1	17.3	196.7	26.5
Shrub/Scrub	258.4	5.0	0.0	0.0	158.7	15.1	235.9	8.2	107.0	13.4	13.9	1.9
Woody Wetlands	336.3	6.5	307.9	5.9	0.2	0.0	92.3	3.2	41.0	5.1	28.0	3.8
Total	5,196.0	100.0	5,241.8	100.0	1,052.6	100.0	2,885.6	100.0	800.5	100.0	742.9	100.0

Source: Jin et al. (2013)

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The ROI does not traverse any communities that have towns or cities with municipal boundaries, although the eastern end of the ROI is near residential developments between the town of Atoka and the city of Millington. There is also a commercial area located near South Millington, Tennessee (i.e., Millington Funeral Home) as well as a number of churches near Alternative Route 7-C (Figure 3.10-2 in Appendix A). Existing infrastructure in the ROI includes roadways, railroad tracks, transmission lines, and pipelines. Three public airports and three private airports are located in the ROI; airports are discussed further in Section 3.16. Within the ROI for the Applicant Proposed Route, the HVDC alternative routes, and the Tennessee Converter Station Siting Area are 128 residential structures, 50 agricultural structures, 6 industrial structures, 3 commercial structures, and 3 churches.

3.10.5.8 Connected Actions

3.10.5.8.1 Wind Energy Generation

Land cover in the WDZs is primarily cultivated crops and grassland/herbaceous. The land cover in each WDZ is listed in Table 3.10-12.

Existing land uses in the WDZs includes agriculture (irrigated and dry crops, feedlots), residences, recreation (municipal parks, hunting areas), wind energy, and oil/gas development. Existing infrastructure includes roadways, railroads, airports, and transmission lines.

State land in the WDZs includes Optima WMA, Schultz WMA, and Oklahoma school trust lands. No federal or tribal lands were identified within the WDZs.

Structures in the WDZs includes residences, agricultural structures such as barns and silos, businesses, oil/gas wells and associated infrastructure, hospitals, churches, and schools, and airports. Residences, businesses, hospitals, and schools are typically concentrated in or near cities and towns. Rural residences are scattered on large parcels of land and generally surrounded by agricultural land uses.

3.10.5.8.1.1 WDZ-A

The land cover in WDZ-A is 60.3 percent cultivated crops, 26.1 percent grassland/herbaceous, 8.3 percent shrub/scrub, and less than 4 percent of all other categories.

Portions of the city of Perryton are within the WDZ, including recreational uses such as Leatherman Park, Murphy Park, Whigham Park, Stark Park, and Whippo Park (all city parks). No state or federal lands are located in the WDZ. Existing uses in the WDZ includes transmission lines north of Perryton and center-pivot irrigation scattered throughout the WDZ. Perryton-Ochiltree County Airport is partially within the WDZ along the eastern border.

3.10.5.8.1.2 WDZ-B

The land cover in WDZ-B is 53.2 percent cultivated crops, 37.8 percent grassland/herbaceous, and less than 5 percent of all other categories.

There are no municipalities or state or federal lands. Recreational uses include Miller’s Lake Public Hunting Area in the central portion of the WDZ. Central-pivot irrigation is found throughout the WDZ. One transmission line crosses the WDZ, and an operating wind energy facility is adjacent to it. Another wind energy facility is present in the northern portion of the WDZ.

3.10.5.8.1.3 WDZ-C

The land cover in WDZ-C is 52.8 percent grassland/herbaceous, 38.8 percent cultivated crops, and less than 5 percent of all other categories.

No municipalities or state or federal lands are present.

Center-pivot irrigation is found throughout the WDZ and a concentrated animal feeding operation is located in the western portion of the WDZ southeast of Stratford, Texas. Transmission lines cross the WDZ. One existing wind energy facility is present in the northeast portion of the WDZ.

3.10.5.8.1.4 WDZ-D

The land cover in WDZ-D is 69.3 percent grassland/herbaceous, 17.8 percent cultivated crops, 7.3 percent shrub/scrub, and less than 6 percent of all other categories.

The town of Hardesty is in the WDZ. No federal lands are present in the WDZ. State lands compose 4.6 percent of the WDZ, including the 256-acre Optima WMA, the 260-acre Schultz WMA, and 2,643 acres of school trust lands. Transmission lines and center-pivot irrigation are present in the northern and southern portions of the WDZ. Two operating wind energy facilities are present in the southwestern portion of the WDZ.

3.10.5.8.1.5 WDZ-E

The land cover in WDZ-E is 57 percent cultivated crops, 31.9 percent grassland/herbaceous, 6.8 percent developed and open space, and less than 4 percent of all other categories.

No municipalities or federal lands are present in the WDZ. There are 404 acres of school trust lands, comprising less than 1 percent of the WDZ. There is an existing wind energy facility in the southwestern portion of the WDZ. Existing uses include transmission lines, wind turbines, center-pivot irrigation, and a concentrated animal feeding operation.

3.10.5.8.1.6 WDZ-F

The land cover in WDZ-F is 67.0 percent grassland/herbaceous, 25.4 percent cultivated crops, and less than 5 percent all other categories.

No federal lands are present in the WDZ. There are 7,263 acres of school trust lands, comprising 6.5 percent of the WDZ. The city of Texhoma and the town of Goodwell are within the WDZ. Center-pivot irrigation is found throughout the WDZ. An existing wind energy facility is present in the southern portion of the WDZ. Existing infrastructure includes transmission lines and a railroad. Texhoma Municipal Airport is located in the southwest corner of the WDZ.

3.10.5.8.1.7 WDZ-G

The land cover in WDZ-G is 53.0 percent grassland/herbaceous, 40.5 percent cultivated crops, and less than 5 percent of all other categories.

No municipalities or federal lands are present in the WDZ. There are 4,886 acres of school trust lands, comprising 2.6 percent of the WDZ. A few parcels with central-pivot irrigation are present in the northern portion of the WDZ. Existing infrastructure includes transmission lines and a railroad.

Table 3.10-12:
Land Cover in Wind Development Zones

WDZ	A		B		C		D		E		F		G		H		I		J		K		L	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Open Water	111.6	0.1	92.2	0.1	185.9	0.1	45.8	0.1	114.8	0.2	59.4	0.1	32.2	0.0	46.0	0.0	57.3	0.1	4.4	0.0	17.3	0.0	102.0	0.1
Developed, Open Space	3,872.3	3.5	5,090.0	4.1	6,318.1	3.9	3,633.6	5.3	3,205.9	6.8	5,228.4	4.6	8,622.0	4.6	4,593.0	4.0	5,708.1	5.4	4,173.1	4.5	4,287.1	4.6	6,459.7	3.9
Developed, Low Intensity	1,345.3	1.2	225.7	0.2	419.3	0.3	81.0	0.1	115.0	0.2	869.7	0.8	147	0.1	28.8	0.0	583.2	0.6	145.9	0.2	67.9	0.1	487.8	0.3
Developed, Medium Intensity	259.2	0.2	24.9	0.0	52.3	0.0	8.5	0.0	19.8	0.0	214.1	0.2	10.0	0.0	0.0	0.0	66.3	0.1	8.3	0.0	8.9	0.0	29.4	0.0
Developed, High Intensity	62.3	0.1	0.0	0.0	9.8	0.0	0.0	0.0	3.1	0.0	8.5	0.0	0.0	0.0	0.0	0.0	20.9	0.0	0.0	0.0	0.0	0.0	2.2	0.0
Barren Land	47.8	0.0	59.8	0.0	41.4	0.0	57.0	0.1	64.0	0.1	59.8	0.1	17.1	0.0	80.5	0.1	37.6	0.0	12.7	0.0	19.8	0.0	163.5	0.1
Deciduous Forest	0.0	0.0	25.6	0.0	22.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	3.3	0.0	27.4	0.0	0.0	0.0	0.0	0.0	1.6	0.0
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.2	0.0
Shrub/Scrub	9,143.7	8.3	5,627.9	4.5	6,595.2	4.1	5,055.2	7.3	1,725.7	3.7	2,002.5	1.8	3,171.0	1.7	1,682.9	1.4	9,149.1	8.7	8,070.2	8.7	6,040.2	6.5	17,683.5	10.7
Grassland/Herbaceous	28,649.1	26.1	47,473.5	37.8	84,957.5	52.8	47,914.3	69.3	15,015.4	31.9	75,363.0	67.0	99,333.5	53.0	94,755.5	81.5	25,086.2	23.8	68,122.3	73.6	39,204.8	42.2	47,079.7	28.4
Pasture/Hay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	66,151.1	60.3	66,784.3	53.2	62,440.5	38.8	12,341.6	17.8	26,819.3	57.0	28,608.2	25.4	75,833.0	40.5	15,030.1	12.9	64,325.1	61.1	11,946.2	12.9	43,194.6	46.5	91,474.2	55.2
Woody Wetlands	19.1	0.0	15.1	0.0	1.6	0.0	51.9	0.1	8.9	0.0	21.1	0.0	1.6	0.0	3.6	0.0	49.1	0.0	83.7	0.1	49.6	0.1	18.9	0.0
Emergent Herbaceous Wetlands	79.0	0.1	60.3	0.0	3.9	0.0	0.0	0.0	0.0	0.0	17.8	0.0	146.3	0.1	2.0	0.0	92.7	0.1	0.0	0.0	1.1	0.0	2,286.7	1.4
Total	109,746.7	100.0	125,479.2	100.0	161,048.1	100.0	69,188.9	100.0	47,091.8	100.0	112,460.6	100.0	187,314.9	100.0	116,225.7	100.0	105,202.9	100.0	92,567.5	100.0	92,893.9	100.0	165,848.4	100.0

Source: Jin et al. (2013)

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3.10.5.8.1.8 WDZ-H

The land cover in WDZ-H is 81.5 percent grassland/herbaceous, 12.9 percent cultivated crops, and less than 4 percent of all other categories.

No municipalities or federal lands are present in the WDZ. There are 2,464 acres of school trust lands, or approximately 2 percent of the WDZ. A few parcels have center-pivot irrigation. Existing infrastructure includes a transmission line crossing the central portion of the WDZ.

3.10.5.8.1.9 WDZ-I

The land cover in WDZ-I is 61.1 percent cultivated crops, 23.8 percent grassland/herbaceous, 8.7 percent shrub/scrub, and less than 6 percent of all other categories.

No federal lands are present in the WDZ. There are 975 acres of school trust lands, or approximately 1 percent of the WDZ. The city of Hooker and Hooker Municipal Airport located within the WDZ. Center-pivot irrigation is found primarily in the central portion of the WDZ. Concentrated animal feeding operations are also found in the WDZ. Existing infrastructure includes transmission lines, center-pivot irrigation, and a railroad.

3.10.5.8.1.10 WDZ-J

The land cover in WDZ-J is 73.6 percent grassland/herbaceous, 12.9 percent cultivated crops, 8.7 percent shrub/scrub, and less than 5 percent of all other categories.

No federal lands are present in the WDZ. There are 2,612 acres of school trust lands, or 2.8 percent of the WDZ. Transmission lines cross the WDZ. Center-pivot irrigation structures are present in the central portion of the WDZ. Active oil/gas development is ongoing.

3.10.5.8.1.11 WDZ-K

The land cover in WDZ-K is 46.5 percent cultivated crops, 42.2 percent grassland/herbaceous, 6.5 percent shrub/scrub, and less than 5 percent of all other categories.

No federal lands are present in the WDZ. There are 963 acres of school trust lands, or approximately 1 percent of the WDZ. Existing infrastructure includes transmission lines and some scattered center-pivot irrigation.

3.10.5.8.1.12 WDZ-L

The land cover in WDZ-L is 55.2 percent cultivated crops, 28.4 percent grassland/herbaceous, 10.7 percent shrub/scrub, and less than 4 percent of all other categories.

No state or federal lands are located in the WDZ. The southern portion of the city of Spearman is located within the WDZ, including Spearman Park. Center-pivot irrigation is found throughout the WDZ.

3.10.5.8.2 Optima Substation

The future Optima substation would be constructed on approximately 160 acres partially within the area identified on Figure 2.1-3 in Appendix A as the AC Interconnection Siting Area. The land cover in the future Optima substation location is primarily grassland herbaceous, with some shrub/scrub and developed open space. No structures or existing infrastructure are located on the 160-acre site, although there are roads and an operating wind farm nearby. Irrigated cultivated crops are also in the vicinity.

3.10.5.8.3 TVA Upgrades

As described in Section 3.1.1, a precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.10.6 Impacts to Land Use

Comments regarding land use received during the scoping period indicate that the public is concerned about impacts to oil and gas drilling activities and the restrictions the Project would place on future land use and development. The public also expressed concern about impacts to conservation efforts and agreements as well as impacts to public lands.

3.10.6.1 Methodology

To identify potential impacts that may result from construction and operations and maintenance of the Project, the analysis of the HVDC transmission line route alternatives, the Oklahoma and Arkansas AC interconnect lines, and the AC collection system routes in Oklahoma was based on a desktop review of existing land uses within a representative 200-foot ROW (100 feet on either side of a representative centerline). The analysis for other elements of the Project, such as the Oklahoma and Tennessee converter stations, was based on a desktop review of the footprint of the layout dated February 2014. Quantitative data regarding the resources directly intersected by the 200-foot-wide representative ROW were used to analyze the likely effects of the Project on land use in the context of the EPMs that would be included as part of the Project. Land cover, jurisdictional areas, and structures within the representative ROW were identified through GIS analysis[1]. In the impacts discussion, the number and type of structures within the representative ROW are listed for informational purposes and for comparisons between Project alternatives, although it is likely that the displacement of structures would be avoided in the final engineering and design of the Project. Existing transmission lines, pipelines, and roadways within 50 feet of the representative ROW were also identified through GIS analysis.

Tensioning and pulling sites outside the ROW have been identified, and the land cover and structures within them were identified by GIS analysis. Because the location of other temporary construction areas, such as the 45 multi-use construction yards (approximately 25 acres each) and fly yards, as well as the access roads, have not yet been determined, these impacts were evaluated in a general quantitative way.

With regard to access roads associated with the converter stations, although exact locations have not yet been determined, to quantify impacts, it was assumed each converter station would have an access road 20 feet wide by up to 1 mile long (2.4 acres), with temporary disturbance up to 35 feet wide (1.8 acres temporary, 4.2 acres total).

Most construction impacts would be short term, while the visual impact of the installed transmission structures would be long term until the Project is decommissioned. Cumulative impacts are addressed in Section 4.3.10.

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[1] The analysis is based on GIS information available at the time of the analysis in September 2014.

The Applicant has developed a comprehensive list of EPMs that will be implemented with the Project to avoid and minimize impacts to existing land use. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically avoid or minimize impacts to existing land use are listed below:

- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-9: Clean Line will avoid and/or minimize damage to drainage features and other improvements such as ditches, culverts, levees, tiles, and terraces; however, if these features or improvements are inadvertently damaged, they will be repaired and or restored.
- GE-10: Clean Line will work with landowners to repair damage caused by construction, operation, or maintenance activities of the Project. Repairs will take place in a timely manner, weather and landowner permitting.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. Clean Line will implement measures to minimize the transfer of mud onto public roads.
- GE-20: Clean Line will conduct construction and scheduled maintenance activities on the facilities during daylight hours, except in rare circumstances that may include, for example, to address emergency or unsafe situations, to avoid adverse environmental effects, to minimize traffic disruptions, or to comply with regulatory or permit requirements.
- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-29: Clean Line will work with landowners and operators of active oil and gas wells, utilities, and other infrastructure to identify and verify the location of facilities and to minimize adverse impacts. Identification may include use of the One Call system (a database that is used to locate underground facilities) and surveying of existing facilities.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.
- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include

consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.

3.10.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Project that would be common to the converter stations, AC interconnection, AC collection system, and Applicant Proposed Route. Impacts from the construction, operations and maintenance, and decommissioning of the Project are discussed separately by Project component.

3.10.6.2.1 Converter Stations and AC Interconnection Siting Areas

This section describes the impacts from the converter stations on either end of the HVDC transmission line and their associated AC interconnection lines.

3.10.6.2.1.1 Construction Impacts

Direct land use impacts during construction would consist of the long-term conversion of land for the converter station and temporary conversion of land within the ROW for the AC interconnection lines. Potential indirect temporary impacts on residences, businesses, schools, and other areas near the construction area would include noise, dust, transportation, health and safety, and visual impacts; all of these are discussed in Sections 3.11, 3.3, 3.16, 3.8, and 3.18, respectively. Utilities such as oil and gas pipelines, water lines, and electrical distribution lines in and near the ROW may be affected for a limited time during construction at a particular location.

3.10.6.2.1.1.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The Oklahoma converter station would be located on undeveloped rangeland; approximately 95 percent of the land cover in the siting area is grassland/herbaceous (Figure 3.10-3 in Appendix A). Construction of this converter station would convert 45 to 60 acres of rangeland to a utility land use. During construction, an additional 5 to 10 acres would be used as laydown areas for equipment. An additional 4.2 acres of rangeland would be converted to access roads (2.4 acres permanent, 1.8 acres temporary).

The Oklahoma AC interconnection would be approximately 2.7 miles long and would temporarily convert approximately 61 acres of primarily undeveloped rangeland to an industrial use. Approximately 0.3 mile, or 12 percent of the route, would be parallel to existing transmission lines (within 50 feet) in an existing ROW and less than 0.1 mile (1.2 percent) of the route would be parallel to existing roads. The land cover in the representative ROW is currently composed of approximately 58 acres of grassland, 5.4 acres of shrub/scrub, and 1.9 acres of developed, open space.

During construction, assembly areas for the pole structures (either lattice or tubular structures) would be required, as well as wire splicing sites and tensioning and pulling sites. Within the 65.5-acre ROW, an assembly area 150 feet wide by 150 feet long for each structure would be required. Assuming five to seven structures per mile would be required, the assembly areas would take up between 7.7 and 10.8 acres within the ROW. Approximately two wire splicing sites, each 100 feet by 100 feet (0.2 acre) would be used within the ROW during construction. Approximately two tensioning and pulling sites, 150 feet wide by 750 feet long, also would be required within the ROW (2.6 acres each, for a total of 5.2 acres).

Two additional tensioning and pulling sites (150 feet wide by 750 feet long) would be required outside the ROW (2.6 acres each, for a total of 5.2 acres) and approximately 25 acres for a multi-use construction yard would be required.

3.10.6.2.1.1.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

The land cover in the Tennessee Converter Station Siting Area is approximately 54 percent cultivated crops, 27 percent pasture/hay, and 11 percent deciduous forest. No center-pivot irrigation or other irrigation infrastructure is known to occur. Although the exact location has not yet been determined, construction of this converter station would convert 45 to 60 acres of currently undeveloped land to a utility land use. During construction, an additional 5 to 10 acres would be required. An additional 4.2 acres of rangeland would be converted to access roads (2.4 acres permanent, 1.8 acres temporary).

The Tennessee AC interconnection would be located entirely within the converter station siting area and would be approximately 0.2 mile long. During construction, assembly areas for the pole structures (either lattice or tubular structures) would be required, as well as wire splicing sites and tensioning and pulling sites. Within the Tennessee converter station ROW, an assembly area 150 feet wide by 150 feet long for each structure would be required. Assuming one to two structures would be required for the 0.2-mile-long line, the assembly areas would take up to 1 acre within the ROW. One wire splicing site 100 feet by 100 feet (0.23 acre) would be used within the ROW during construction. Also within the ROW, approximately two tensioning and pulling sites 150 feet wide by 750 feet long would be required (2.6 acres each, for a total of 5.2 acres).

Outside the ROW, two additional tensioning and pulling sites of the same dimension would be required (2.6 acres each, for a total of 5.2 acres) and approximately 25 acres for a multi-use construction yard would be required.

3.10.6.2.1.2 Operations and Maintenance Impacts

Operation and maintenance would result in direct long-term impacts to the land crossed by the ROW because of the vegetation that would be allowed to grow and structures and uses that would be permitted. The presence of the converter stations would remove certain areas from other uses until decommissioning and transmission line structures may interfere with other uses in the ROW, such as farming equipment.

Land uses that would not be permitted in the ROW include buildings or structures, changes in grading and land contours, and some restrictions and coordination for infrastructure such as fences and irrigation lines. Access would be restricted during the performance of maintenance activities.

Maintenance for an individual alternative or Project component would be similar to construction impacts, except maintenance would require shorter work duration and would be at a smaller scale. Maintenance would typically occur on an annual basis and as needed.

3.10.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

After construction is complete, only the 45- to 60-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 45 acres would be fenced.

Within the 3-mile-long Oklahoma AC interconnect ROW, only the pole structures would remain. For lattice structures, the operational footprint would be 5 to 7 structures per mile, or 15 to 21 structures total, each 28 feet by 28 feet (less than 0.1 acre), up to 0.4 acre total. For tubular structures, the operational footprint would be 5 to 7 structures per mile, or 15 to 21 structures total, each 7 feet by 7 feet (less than 0.1 acre), and less than 0.1 acre total. For both lattice and tubular structures, each structure would be 75 to 180 feet tall. All other land in the ROW could return to previous land uses, primarily grazing. Access roads that are not needed for operations and maintenance of the Project would be restored.

3.10.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

After construction is complete, only the 45- to 60-acre converter station, the AC Interconnect pole structures, and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily cultivated crops and pasture/hay. Approximately 45 acres would be fenced.

For lattice structures, the operational footprint would be five to seven structures for 1 mile, each 28 feet by 28 feet (less than 0.1 acre total). For tubular structures, the operational footprint would be five to seven structures, each 7 feet by 7 feet (less than 0.1 acre), up to less than 0.1 acre total. For both lattice and tubular structures, each structure would be 75 to 180 feet tall. All other land in the ROW that is not within the converter station could return to previous land uses. Access roads that are not needed for operations and maintenance of the Project would be restored.

3.10.6.2.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could return to the preconstruction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.2.2 AC Collection System

This section discusses the impacts from the AC collection system. The Applicant Proposed Project would include four to six AC collection lines of up to 345kV from the Oklahoma converter station to points in the Oklahoma and Texas panhandles.

3.10.6.2.2.1 Construction Impacts

The AC collection system lines would vary in length between 13 and 56 miles each. Within the ROW for each transmission line, an assembly area for the pole structures (whether lattice, tubular, or H-frame, the assembly area footprint is the same) would be required. Each assembly area would be 150 feet wide by 150 feet long and five to seven assembly areas per mile would be required. Assuming 330 miles of AC collection lines, the total acreage of assembly areas would range between 775 and 1,085 acres. Total disturbance from the construction of access roads (inside and outside the ROW) for the AC collection system would be approximately 301 miles, or 669 acres.

Temporary work areas that would be required outside the ROW include fiber optic regeneration sites, multi-use construction yards, and fly yards. Approximately six fiber optic regeneration sites would be required. Each site would be approximately 100 feet by 100 feet, with a fenced area of approximately 75 feet by 75 feet. The regeneration equipment would be enclosed in a small control building made of either metal or concrete, approximately 12 feet by 32 feet by 9 feet tall. An access road and power supply to the site would be required, but the same road would be used to access the transmission line, so those access road impacts are included in the impacts for the transmission line. Typically, these sites would be adjacent to or within 750 feet of the ROW. A total of approximately 1.4 acres of undeveloped land would be converted to a utility use for the six fiber optic regeneration sites.

Multi-use construction yards would each be approximately 25 acres in size and would be located approximately 25 miles apart and typically within 10 miles of the ROW. Assuming the AC interconnection requires approximately 15 multi-use construction yards, the total footprint would be approximately 375 acres for all 15 yards. Fly yards would each require 10 to 15 acres each and would be located at approximately 5-mile intervals along the ROW and typically within 10 miles of the ROW. Assuming a total of 60 fly yards, 15 of which would be located within multi-use construction yards, 45 fly yards would have a total footprint of 450 to 675 acres.

Potential temporary impacts on residences, businesses, schools, and other areas near the construction area would include noise, dust, transportation, health and safety, and visual impacts; all of these are discussed in Sections 3.11, 3.3, 3.16, 3.8, and 3.18, respectively. Utilities such as oil and gas pipelines, water lines, and electrical distribution lines in and near the ROW may be affected for a limited time during construction at a particular location. The majority of the impacts to agriculture would be temporary. Construction would temporarily prevent the use of rangeland and cultivated crops in the ROW. Impacts to agriculture are addressed in greater detail in Section 3.2.

The sections below and Table 3.10-13 describe the land cover that would be affected within each alternative. The sections below also describe the structures that would be affected by each alternative. For each route, it is assumed that the entire acreage within the ROW would be temporarily disturbed during construction, although construction would not occur on the entire length of a route at the same time.

3.10.6.2.2.1.1 Route E-1

AC Collection System Route E-1 would disturb approximately 708 acres. The predominant land cover is grassland herbaceous (574.2 acres, or 81.1 percent of the representative ROW). Less than 0.1 mile (0.1 percent) of the representative ROW is parallel to existing transmission lines and less than 0.1 mile (0.1 percent) is parallel to existing roads. One agricultural structure and one industrial structure are present in the representative ROW.

3.10.6.2.2.1.2 Route E-2

AC Collection System Route E-2 would disturb approximately 974 acres. The land cover is primarily grassland/ herbaceous (572.8 acres, or 58.8 percent of the representative ROW) and cultivated crops (298.6 acres, or 30.6 percent of the ROW). Approximately 18 acres (2 percent of the representative ROW) are Oklahoma school trust lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.1 mile (0.3 percent) of the representative ROW is parallel to existing transmission lines and approximately 1.1 miles (2.8 percent) is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.3 Route E-3

AC Collection System Route E-3 would disturb approximately 978 acres. The land cover is primarily grassland/herbaceous (650.3 acres, or 66.5 percent of the representative ROW). Approximately 50 acres (5 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Less than 0.1 mile (0.2 percent) of the representative ROW is parallel to existing transmission lines and 1.4 miles (3.6 percent) is parallel to existing roads. Two agricultural structures and one residential structure are present in the representative ROW.

3.10.6.2.2.1.4 Route NE-1

AC Collection System Route NE-1 would disturb approximately 730 acres. The land cover is primarily grassland/herbaceous (291.1 acres, or 39.9 percent of the representative ROW) and cultivated crops (247.2 acres, or

33.9 percent of the ROW). Approximately 27 acres (4 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.2 mile (0.6 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.5 Route NE-2

AC Collection System Route NE-2 would disturb approximately 637 acres. The land cover is primarily grassland/herbaceous (450.2 acres, or 70.6 percent of the representative ROW). Approximately 25 acres (4 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.2 mile (0.8 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. One residence and one agricultural structure are present in the representative ROW.

3.10.6.2.2.1.6 Route NW-1

AC Collection System Route NW-1 would disturb approximately 1,265 acres. The land cover is primarily grassland/herbaceous (609.5 acres, or 48.2 percent of the representative ROW) and developed, open space (540.2 acres, or 42.7 percent of the ROW). Approximately 71 acres (6 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 12 miles (22.8 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. One agricultural structure and one industrial structure are present in the representative ROW.

3.10.6.2.2.1.7 Route NW-2

AC Collection System Route NW-2 would disturb is approximately 1,365 acres. The land cover is primarily grassland/herbaceous (629.3 acres, or 46.1 percent of the representative ROW), cultivated crops (410.9 acres, or 30.1 percent of the ROW), and developed, open space (292.0 acres, or 21.4 percent of the ROW). Approximately 25 acres (2 percent of the representative ROW) are Oklahoma school lands that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.1 mile (0.2 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.8 Route SE-1

AC Collection System Route SE-1 would disturb is approximately 979 acres. The land cover is primarily grassland/herbaceous (513.2 acres, or 52.4 percent of the representative ROW) and cultivated crops (340.0 acres, or 34.7 percent of the ROW). Approximately 0.1 mile (0.3 percent) of the representative ROW is parallel to existing transmission lines and 2.7 miles (6.6 percent) is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.9 Route SE-2

AC Collection System Route SE-2 would disturb is approximately 325.4 acres. The land cover is primarily grassland/herbaceous (169.9 acres, or 52.2 percent of the representative ROW) and cultivated crops (130.6 acres, or 40.1 percent of the ROW). Approximately 0.3 mile (1.9 percent) of the representative ROW is parallel to existing transmission lines and 0.1 mile (0.8 percent) is parallel to existing roads. No structures are present in the representative ROW.

Table 3.10-13:
Land Cover in the AC Collection System Representative ROW, by Route

		Barren Land (Rock/Sand/Clay)	Cultivated Crops	Developed, High Intensity	Developed, Low Intensity	Developed, Medium Intensity	Developed, Open Space	Emergent Herbaceous Wetlands	Grassland/ Herbaceous	Open Water	Shrub/ Scrub	Woody Wetlands	Total
E-1	Acres	0.0	48.8	0.0	0.6	0.0	32.8	0.0	574.2	0.0	50.9	0.7	708.0
	Percent	0.0	76.9	0.0	0.1	0.0	4.6	0.0	81.1	0.0	7.2	0.1	100.0
E-2	Acres	0.0	280	0.0	0.5	0.0	26.3	0.0	572.8	0.0	74.5	1.8	974.4
	Percent	0.0	30.7	0.0	0.1	0.0	2.7	0.0	58.8	0.0	7.6	0.2	100.0
E-3	Acres	0.0	105.2	0.0	0.9	0.0	174.0	0.0	650.3	0.0	47.1	0.0	977.5
	Percent	0.0	10.8	0.0	0.1	0.0	17.8	0.0	66.5	0.0	4.8	0.0	100.0
NE-1	Acres	0.0	247.2	0.0	7.3	0.5	141.7	1.2	291.1	0.0	40.7	0.0	729.8
	Percent	0.0	33.9	0.0	1.0	0.1	19.4	0.2	39.9	0.0	5.6	0.0	100.0
NE-2	Acres	0.5	50.2	0.0	0.8	0.0	103.8	0.0	450.2	0.0	32.1	0.0	637.4
	Percent	0.1	7.9	0.0	0.1	0.0	16.3	0.0	70.6	0.0	45.0	0.0	100.0
NW-1	Acres	0.0	85.0	0.0	15.1	0.0	540.2	0.0	609.5	0.0	15.6	0.0	1,265.4
	Percent	0.0	6.7	0.0	1.2	0.0	42.7	0.0	48.2	0.0	1.2	0.0	100.0
NW-2	Acres	0.0	410.9	0.0	6.2	0.5	292.0	0.0	629.3	0.0	26.1	0.0	1,365.0
	Percent	0.0	30.1	0.0	0.5	0.0	21.4	0.0	46.1	0.0	1.9	0.0	100.0
SE-1	Acres	0.0	340.0	0.0	0.2	0.0	64.2	0.0	513.2	1.9	59.4	0.0	979.4
	Percent	0.0	34.7	0.0	0.0	0.0	6.6	0.0	52.4	0.2	6.1	0.0	100.0
SE-2	Acres	0.0	130.6	0.0	0.0	0.0	20.6	0.0	169.9	0.0	4.4	0.0	325.4
	Percent	0.0	40.1	0.0	0.0	0.0	6.3	0.0	52.2	0.0	1.3	0.0	100.0
SE-3	Acres	0.0	483.9	0.0	10.9	0.0	71.8	0.0	565.7	0.0	59.6	1.8	1,193.6
	Percent	0.0	40.5	0.0	0.9	0.0	6.0	0.0	47.4	0.0	5.0	0.1	100.0
SW-1	Acres	0.0	0.0	0.0	0.7	0.0	9.5	0.0	312.8	0.0	2.6	0.0	325.6
	Percent	0.0	0.0	0.0	0.2	0.0	2.9	0.0	96.1	0.0	0.8	0.0	100.0
SW-2	Acres	0.0	33.6	0.0	1.5	0.0	122.7	0.0	733.0	0.0	10.6	0.0	901.4
	Percent	0.0	3.7	0.0	0.2	0.0	13.6	0.0	81.3	0.0	1.2	0.0	100.0
W-1	Acres	0.0	47.2	0.0	1.8	1.1	69.4	0.0	377.0	0.0	11.5	0.0	507.8
	Percent	0.0	9.3	0.0	0.4	0.2	13.7	0.0	74.2	0.0	2.3	0.0	100.0

Source: Jin et al. (2013)

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3.10.6.2.2.1.10 Route SE-3

AC Collection System Route SE-1 would disturb approximately 1,194 acres. The land cover is primarily grassland/herbaceous (565.7 acres, or 47.4 percent of the representative ROW) and cultivated crops (483.9 acres, or 40.5 percent of the ROW). Approximately 18 acres (2 percent of the representative ROW) are Oklahoma school that would be temporarily unavailable for agriculture and oil/gas development. Approximately 0.1 mile (0.2 percent) of the representative ROW is parallel to existing transmission lines and 11.9 miles (24.2 percent) is parallel to existing roads. No structures are present in the ROW.

3.10.6.2.2.1.11 Route SW-1

AC Collection System Route SW-1 would disturb approximately 326 acres. The land cover is almost entirely grassland/herbaceous (312.8 acres, or 96.1 percent of the representative ROW). Approximately 0.2 mile (1.6 percent) of the representative ROW is parallel to existing transmission lines and 0.2 mile (1.2 percent) is parallel to existing roads. No structures are present in the representative ROW.

3.10.6.2.2.1.12 Route SW-2

AC Collection System Route SW-2 would disturb approximately 901 acres. The predominant land cover is grassland/herbaceous (733.0 acres, or 81.3 percent of the representative ROW). Less than 0.1 mile (0.1 percent) of the representative ROW is parallel to existing transmission lines and 4.2 miles (11.2 percent) is parallel to existing roads. One industrial structure is present in the ROW.

3.10.6.2.2.1.13 Route W-1

AC Collection System Route W-1 would disturb is approximately 508 acres. The predominant land cover is grassland/herbaceous (377.0 acres, or 74.2 percent of the representative ROW). Less than 0.1 mile (0.4 percent) of the representative ROW is parallel to existing transmission lines; none of the route is parallel to existing roads. One agricultural structure and one industrial structure are present in the ROW.

3.10.6.2.2.2 Operations and Maintenance Impacts

Within the AC collection system ROW (four to six ROWs, varying in length between 13 and 56 miles), the only Project components that would remain during operations and maintenance would be the pole structures and most access roads.

Because the type of transmission structure that would be used has not yet been determined, the potential disturbance for each type was estimated. For lattice structures, the operational footprint would be five to seven structures per mile, and each would have 28 feet by 28 feet foundation (less than 0.1 acre). Assuming 300 miles of lattice structures, the operational footprint would be up to 37.8 acres. For tubular pole structures, the operational footprint would be five to seven structures per mile, each 49 square feet, up to 2.4 acres total. For H-frame structures, the operational footprint would be two poles spaced 25 feet apart, each with a 7 feet x 7 feet footprint. All of the structures would be 75 to 180 feet tall. Impact calculations assumed lattice structures would be used for a conservative estimate of potential impacts.

It is anticipated that all existing roads and existing roads with repairs/improvements would be retained for operations and maintenance of the Project. It is estimated that approximately 75 percent of the new overland roads with no improvements and 90 percent of the new overland roads with clearing and new bladed roads would be retained for operations and maintenance access. These roads would be up to 20 feet wide. Access roads that are not needed for operations and maintenance would be restored.

All other land in the ROW could return to most previous land uses if they are compatible with operations and maintenance of the Project. Some land uses, such as forest land, would not be permitted due to height restrictions for vegetation below the transmission lines. Some uses may be impeded in the ROW, such as using farming equipment near the pole structures or crop-dusting planes that would not be able to approach the transmission lines. Land uses that would not be permitted in the ROW include buildings or structures, changing the grading and land contours, and some restrictions and coordination for infrastructure such as fences and irrigation lines. In addition, access would be restricted during the performance of maintenance activities. All of the tensioning and pulling areas could return to existing uses once construction has been completed.

The long-term impacts by route are summarized in Table 3.10-14 for structures. No permanent impacts are described for access roads, because the location of access roads has not yet been determined.

Table 3.10-14:
Impacts During the Operational Phase of the AC Collection Lines

AC Collection System Route	Length (miles)	Estimated Footprint of Structures (acres)[1]
E-1	29	4.06
E-2	40	5.6
E-3	40	5.6
NE-1	30	4.2
NE-2	26	3.6
NW-1	52	7.3
NW-2	56	7.8
SE-1	40	5.6
SE-2	13	1.8
SE-3	49	6.9
SW-1	13	1.8
SW-2	37	5.2
W-1	21	2.9

1 For a conservative estimate of impacts, the anticipated footprint of structures assumes seven lattice structures per mile; each would have a 28-foot by 28-foot foundation (less than 0.1 acre).

3.10.6.2.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning has been completed, all land could return to the pre-construction land uses described in Sections 3.10.4 and 3.10.5.

3.10.6.2.3 HVDC Applicant Proposed Route

This section identifies the potential land use impacts of the approximate 720 mile-long transmission facility during the three phases of the Project: construction, operations and maintenance, and decommissioning. Specific EPMs developed to avoid and minimize land use impacts are described in Section 3.10.6.1 and Section 3.10.6.7 and are referenced in the discussion below in parentheses.

3.10.6.2.3.1 Construction Impacts

Construction would begin with clearing and grading for access roads, pole structure sites and assembly areas, wire splicing sites, and tensioning and pulling sites. These areas would not be available for agricultural use during construction. Within the ROW, trees would need to be removed. Individual transmission structure sites would be cleared. Hand, mechanized, and chemical clearing may be used. For tensioning and pulling sites, clearing would be limited to the removal of larger woody vegetation or dense brush that may interfere with tensioning equipment; grading would also be limited to what is necessary to provide temporary access for tensioning equipment.

Within or adjacent to the ROW for the transmission line, all trees would be removed. In the border zone adjacent to the ROW, some small trees may remain if they would not pose a risk of falling into the conductors.

The ROW would be 200 feet wide by approximately 720 miles. Within the ROW, assembly areas for the pole structures, tensioning and pulling sites, and wire-splicing sites would be required during construction. The lattice structures would require areas 200 feet wide by 200 feet long for each structure, four to six areas per mile. Monopole structure assembly would require areas 200 feet wide by 200 feet long for each structure, five to seven structures per mile. Guyed structures (structures that are stabilized by tensioned cables) would require an assembly area 200 feet wide by 300 feet long and would be required in limited situations, such as in turns in the line and deadends. Lattice crossing structures would require an assembly area 200 feet wide by 300 feet long and would be required in limited situations (e.g., Mississippi River and Arkansas River crossings). Tensioning and pulling sites inside the ROW would require areas 200 feet wide by 750 feet long, or 3.4 acres for approximately 90 sites, for a total of 306 acres. Each wire-splicing site would require 100 feet wide by 100 feet long and would be spaced 1 to 3 miles apart. Assuming 360 sites, the total footprint of wire-splicing sites for the HVDC transmission line would be 82.6 acres.

Outside the ROW, roads to access the transmission line and all work areas during construction would be required. Total disturbance for all access roads for the transmission lines would be approximately 2,660 acres.

Access roads would include existing roads, existing roads with repairs/improvements, and new roads. New roads would include overland roads with no clearing or grading, overland roads with clearing and minor grading, and new bladed roads. Paving of roads would be limited to the approach aprons at intersections with existing paved roads, unless otherwise required by local jurisdictional authorities.

Construction would not impact existing roads that do not need any improvements. For existing roads that would require repairs or improvements, the disturbance areas would include a total width of 35 feet, minus the width of the existing road.

Disturbance areas for new roads would be 35 feet wide for most of the Project, but in areas with steep side slopes (greater than 15 percent), the construction disturbance may be up to 50 feet wide. For new overland roads with no vegetation clearing, vehicular traffic would use an area 14-20 feet wide. For overland roads that require vegetation clearing, up to 20 feet wide would be cleared within a total disturbance corridor 35 feet wide.

Also outside the ROW, additional areas for fiber optic regeneration sites, tensioning and pulling sites, multi-use construction yards, and fly yards would be required. Approximately 14 fiber optic regeneration sites would be required. Each site would be approximately 100 feet wide by 100 feet long, with a fenced area of approximately 75 feet by 75 feet. The regeneration equipment would be enclosed in a small control building made of either metal or concrete, approximately 12 feet by 32 feet by 9 feet tall. An access road and power supply to the site would be required. Typically, these sites would be adjacent to or within 750 feet of the ROW. A total of approximately 3.2 acres of undeveloped land would be converted to a utility use for the 14 fiber optic regeneration sites. Tensioning and pulling sites outside the ROW (or partially outside the ROW) would be required where the line turns more than 8 degrees. Each tensioning and pulling site would require areas 200 feet wide by 750 feet long. It is assumed that approximately 270 of these sites would be at least partially outside the ROW, for a total of 918 acres.

Multi-use construction yards would each be approximately 25 acres in size and would be located approximately 25 miles apart and typically within 10 miles of the ROW. Assuming approximately 29 yards, the total footprint would be approximately 725 acres. Fly yards would each require 10 to 15 acres and would be located at approximate 5-mile intervals along the ROW and typically within 10 miles of the ROW. Of a total of 144 fly yards, 29 of which would be located within multi-use construction yards, 115 would have a total footprint of 1,150 to 1,725 acres. All of these areas would be temporary and would be revegetated once the construction phase has been completed.

Potential temporary impacts on residences, businesses, schools, and other areas near the construction area would include noise, dust, transportation, safety issues, and visual impacts; all of these are discussed in Sections 3.11, 3.3, 3.16, 3.8, and 3.18, respectively. Utilities such as oil and gas pipelines, water lines, and electrical distribution lines in and near the ROW may be affected during construction, although identification and verification of the location of these facilities by the Applicant would minimize impacts.

The majority of the impacts to agriculture would be temporary. Construction would prevent the use of rangeland and cultivated crops in the ROW in a specific location and may change the contour of the land and affect irrigation infrastructure. Impacts to agriculture are addressed in greater detail in Section 3.2.

Potential impacts to oil and gas wells would occur in Regions 1, 2, 3, and 5 of the Project. Construction of the Project could conflict with drilling equipment, but would be minimized by coordination with landowners and/or well operators during construction. Impacts to subsurface collection systems and other infrastructure would be minimized by locating these facilities prior to clearing, grading, and foundation excavation activities were conducted for the Project.

3.10.6.2.3.1.1 Region 1

The Applicant Proposed Route in Region 1 is approximately 115 miles long. Approximately 2 miles (1.4 percent) is parallel to existing transmission lines and 8 miles (7.0 percent) is parallel to existing roads. The land cover in the 200-foot representative ROW for Region 1, listed in Table 3.10-15, is primarily grassland herbaceous (1,742.3 acres or 61.7 percent) and cultivated crops (748.8 acres or 26.5 percent)

Table 3.10-15:
Land Cover in the Applicant Proposed Route—Region 1

Land Cover	Link 1		Link 2		Link 3		Link 4		Link 5		Total Region 1	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.1	0.0	0.0	0.8	0.0
Cultivated Crops	0.0	0.0	535.1	41.1	0.0	0.0	108.8	13.5	104.8	16.0	748.8	26.5
Deciduous Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Developed, Low Intensity	0.0	0.0	0.9	0.1	0.0	0.0	0.0	0.0	2.7	0.4	3.6	0.1
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.1	0.7	0.1	1.3	0.0
Developed, Open Space	1.9	4.0	77.3	5.9	0.0	0.0	23.4	2.9	67.3	10.3	169.6	6.0
Grassland/Herbaceous	42.8	90.0	590.4	45.4	14.1	93.6	641.0	79.4	456.6	69.8	1,742.3	61.7
Open Water	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	11.7	1.8	12.1	0.4
Shrub/Scrub	2.8	26.0	96.6	7.4	1.0	6.4	29.1	3.6	9.6	1.5	139.0	4.9
Woody Wetlands	0.0	0.0	0.7	0.0	0.0	0.0	3.7	0.5	0.4	0.1	4.8	0.2
Total	3.0	100.0	1,301.0	100.0	15.0	100.0	807.8	100.0	654.0	100.0	2,822.3	100.0

Source: Jin et al. (2013)

Approximately 18 acres of Oklahoma school trust lands is present in Applicant Proposed Route Link 2, 4 acres in Link 4, and 31 acres in Link 5 that would be temporarily unavailable for other uses, totaling 54 acres (2 percent of the representative ROW). One commercial structure and one agricultural structure (in Link 4) are present in the representative ROW.

Outside the ROW, tensioning and pulling areas totaling approximately 100.8 acres would be required during construction and would be unavailable for other uses. The land cover in these areas is primarily grassland/herbaceous land and cultivated crops. Approximately 0.5 acre is school trust lands. No structures are present in these areas.

3.10.6.2.3.1.2 Region 2

The Applicant Proposed Route in Region 2 is approximately 106 miles long. Approximately 1 mile (1.2 percent) is parallel to existing transmission lines and 12 miles (11.7 percent) is parallel to existing roads. The land cover in the 200-foot representative ROW for Region 2 is listed in Table 3.10-16. The land cover in the ROW is primarily grassland herbaceous (1,299.9 acres or 50.3 percent), cultivated crops (788.0 acres or 30.5 percent), evergreen forest (200.0 acres, or 7.7 percent), and developed, open space (218.0 acres or 8.4 percent).

Table 3.10-16:
Land Cover in the Applicant Proposed Route—Region 2

Land Cover	Link 1		Link 2		Link 3		Total	
	Acres	%	Acres	%	Acres	%	Acres	%
Cultivated Crops	46.1	9.3	414.7	31.2	328.7	43.0	788.0	30.5
Deciduous Forest	0.0	0.0	7.5	0.6	14.9	1.9	22.3	0.9
Developed, Low Intensity	1.5	0.3	8.7	0.7	0.7	0.1	10.9	0.4
Developed, Medium Intensity	0.0	0.0	1.9	0.1	0.6	0.1	2.5	0.1
Developed, Open Space	17.5	3.6	51.5	3.9	149.0	19.5	218.0	8.4
Evergreen Forest	5.6	1.1	193.4	14.5	1.0	0.1	200.0	7.7
Grassland/Herbaceous	421.7	85.4	609.5	45.8	268.8	35.2	1,299.9	50.3
Mixed Forest	0.0	0.0	30.6	2.3	0.0	0.0	30.6	1.2
Open Water	0.0	0.0	5.3	0.4	0.1	0.0	5.3	0.2
Shrub/Scrub	1.3	0.3	7.8	0.6	0.0	0.0	9.2	0.4
Total	493.7	100.0	1,330.7	100.0	763.6	100.0	2,586.7	100.0

Source: Jin et al. (2013)

Approximately 31 acres of Oklahoma school trust lands are present in Applicant Proposed Route Link 1, 55 acres in Link 2, and 12 acres in Link 3 that would be temporarily unavailable for other uses, totaling 97 acres (4 percent of the representative ROW). Two commercial structures (one each in Link 2 and Link 3), two industrial structures (in Link 2), and two agricultural structures (in Link 3) are present in the representative ROW.

Outside the ROW, tensioning and pulling areas totaling approximately 99.0 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover types are grassland/herbaceous and cultivated crops. The 3 acres of school trust lands in Applicant Proposed Route Link 1 and 3 acres in Link 3 would be temporarily unavailable for other uses. No structures are present in these areas.

3.10.6.2.3.1.3 Region 3

The Applicant Proposed Route in Region 3 is approximately 162 miles long. Approximately 3 miles (2 percent) is parallel to existing transmission lines and 8.8 miles (5.4 percent) is parallel to existing roads. The land cover in the 200-foot representative ROW for Region 3 is listed in Table 3.10-17. Land cover in Region 3 is more variable than the two westernmost regions (regions 1 and 2); specifically, there are more forested areas. The land cover in the Applicant Proposed Route is grassland/herbaceous (1,339.5 acres or 33.9 percent), deciduous forest (1,098.2 acres or 27.8 percent), and pasture/hay (941.3 acres or 23.9 percent).

Table 3.10-17:
Land Cover in the Applicant Proposed Route—Region 3

Land Cover	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.1	0.0	0.0	0.0	0.0	2.6	0.1
Cultivated Crops	196.2	20.1	7.0	10.4	34.4	20.6	68.9	3.7	6.2	0.9	0.0	0.0	312.6	7.9
Deciduous Forest	210.7	21.6	5.2	6.7	41.8	25.1	675.4	36.1	84.4	12.6	80.8	42.6	1,098.2	27.8
Developed, High Intensity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, Low Intensity	0.7	0.1	0.2	0.2	0.0	0.0	2.5	0.1	0.8	0.1	1.0	0.5	5.2	0.1
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.6	0.3	1.2	0.0
Developed, Open Space	67.0	6.5	2.6	3.3	4.9	3.0	79.2	4.2	21.3	3.2	9.4	5.0	184.4	4.7
Evergreen Forest	25.8	2.6	1.9	2.5	8.3	5.0	9.0	0.5	2.2	0.3	0.0	0.0	47.2	1.2
Grassland/Herbaceous	467.6	47.9	49.1	64.0	75.8	45.5	562.1	30.0	161.1	24.1	24.4	12.9	1,339.5	33.9
Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Open Water	3.2	0.3	0.3	0.3	0.0	0.0	6.6	0.4	2.3	0.3	0.2	0.1	12.5	0.3
Pasture/Hay	5.9	0.6	9.9	12.9	1.5	0.9	464.8	24.8	388.2	58.2	73.2	38.6	941.3	23.9
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.7	0.0
Total	862.0	100.0	76.8	100.0	166.7	100.0	1,871.8	100.0	667.1	100.0	189.7	100.0	3,945.5	100.0

Source: Jin et al. (2013)

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Approximately 48 acres of Oklahoma State University land in Applicant Proposed Route Link 1 is currently used as a research area. Eighty-seven acres of school trust land (33 acres in Link 1, 1 acre in Link 2, 26 acres in Link 3, and 27 acres in Link 4) are present in the representative ROW. Approximately 4 acres in Link 6 are part of the Webbers Falls Lock and Dam and Reservoir and managed by Arkansas Riverbed Authority. All of these areas would be temporarily unavailable during construction in this location. Flood control dams constructed by NRCS would be crossed by and adjacent to Link 4. Two residences (one each in Link 2 and Link 5), two industrial structures (one each in Link 1 and Link 4), and two agricultural structures (one each in Link 4 and Link 6) are present in the representative ROW.

Outside the ROW, tensioning and pulling areas totaling approximately 379 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is grassland/herbaceous. Approximately 1 acre in Applicant Proposed Route Link 1 is Oklahoma State University land used for research. Sixteen acres of school trust lands are present (9 acres in Link 1, less than 0.1 acre in Link 2, 6 acres in Link 3, and 2 acres in Link 4). Approximately 1 acre of Link 6 is part of the Webbers Falls Lock and Dam and Reservoir. All of these areas would be temporarily unavailable for other uses during construction. No existing structures are present in these areas.

3.10.6.2.3.1.4 Region 4

The Applicant Proposed Route in Region 4 is approximately 126 miles long. Approximately 2 miles (1.4 percent) is parallel to existing transmission lines and 7 miles (5.5 percent) is parallel to existing roads. The land cover in the 200-foot representative ROW for Region 4 is listed in Table 3.10-18. In contrast to the two westernmost regions (Regions 1 and 2), the land cover in Region 4 is dominated by pasture/hay and forest land. The land cover in the representative ROW is 1,436.1 acres (46.6 percent) pasture/hay, 813.7 acres (26.4 percent) deciduous forest, and 404.7 acres (13.1 percent) evergreen forest.

The Lee Creek Variation is 3.4 miles long. None of the route is parallel to existing infrastructure. The land cover in the 200-foot representative ROW is 94.4 percent forest land. Like all forested areas in the ROW, trees within the ROW would have to be removed for the life of the Project if this route is selected.

Approximately 17 acres (8 percent of the Applicant Proposed Route Link 1 representative ROW) includes the USACE-managed Webbers Falls Lock and Dam and Reservoir (managed by Arkansas Riverbed Authority) and 2.5 acres (less than 1 percent of the representative ROW) crosses the edge of the USFS-managed Ozark National Forest.

The representative ROW of Link 6 also crosses through an edge of the Frog Bayou WMA and a thin arm of the Ozark Lake WMA, so disturbance to the primary portions of both WMAs are likely to be minimal. Approximately 2 acres cross the Ozark Lake WMA, and 4 acres cross the Frog Bayou WMA. These areas would be temporarily unavailable for other uses such as hunting during construction.

The representative ROW of Link 6 includes two parcels of land enrolled in the WRP totaling approximately 6 acres. Under these easements, most land use rights are transferred to the USDA, and getting approval for development of the Project on these lands may be difficult because the Project may not be viewed as compatible with the protection and restoration of wetlands. Flood control dams constructed by NRCS are adjacent to Link 3.

Five agricultural structures (two in Link 6, one in Link 7, and two in Link 9) are present in the representative ROW.

Outside the ROW, tensioning and pulling areas totaling approximately 483 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is pasture/hay followed by deciduous forest. Less than 0.1 acre in Applicant Proposed Link 1 is part of Webbers Falls Lock and Dam and Reservoir, and 4 acres in Link 6 are part of Frog Bayou WMA. These areas would be temporarily unavailable for existing uses during construction. Two residences and one agricultural structure are present in these areas.

3.10.6.2.3.1.5 Region 5

The Applicant Proposed Route in Region 5 is approximately 113 miles long. Approximately 0.3 mile (0.3 percent) is parallel to existing transmission lines and 7 miles (6.2 percent) is parallel to existing roads. The land cover in the 200-foot representative ROW for Region 5 is listed in Table 3.10-19. The land cover in Region 5 is dominated by forest land. The land cover in the representative ROW is approximately 811 acres (29.4 percent) deciduous forest and 773 acres (28.1 percent) pasture/hay.

Approximately 77 acres of the Cherokee WMA are within the representative ROW for the Applicant Proposed Route 52 acres in Link 2 and 25 acres in Link 5) and would temporarily be unavailable for other uses during construction in this location. WMAs are primarily used for recreation, such as hunting (see Section 3.12). Two abandoned structures (one each in Link 4 and Link 5), one agricultural structure (in Link 2), and one other structure (in Link 6, use unknown) are present in the representative ROW.

Outside the ROW, tensioning and pulling areas totaling approximately 291 acres would be required during construction. The land cover in these areas is primarily pasture/hay and deciduous forest. Approximately 6 acres of the Cherokee WMA is within the tensioning and pulling area for Link 2 and would be temporarily unavailable during construction at this location. No existing structures are present in these areas.

3.10.6.2.3.1.6 Region 6

The Applicant Proposed Route in Region 6 is approximately 54 miles long. Approximately 0.3 mile (0.5 percent) is parallel to existing transmission lines and 7 miles (12.7 percent) is parallel to existing roads. The land cover in the 200-foot representative ROW for Region 6 is listed in Table 3.10-20. The land cover in the representative ROW consists of approximately 1,056 acres (79.6 percent) cultivated crops. Typical crops include winter wheat, soybeans, rice, and corn (NASS 2013).

In Link 7, approximately 0.5 acre (less than 1 percent of the representative ROW) crosses the Singer Forest Natural Area easement and approximately 0.3 acre crosses the St. Francis Sunken Lands WMA. The natural area and WMA share approximate boundaries. This area would be temporarily unavailable for other uses (primarily hunting) during construction in this location. Hunting and wildlife viewing may also be temporarily reduced in areas near construction due to noise and removal of vegetation; this would be an indirect short term impact. Five agricultural structures (one in Link 4 and four in Link 6) are present in the representative ROW.

Outside the ROW, tensioning and pulling areas totaling approximately 115.6 acres would be required during construction and would be temporarily unavailable for other uses. The land cover in these areas is primarily cultivated crops. No existing structures are present in these areas.

Table 3.10-18:
Land Cover in the Applicant Proposed Route—Region 4

Land Cover	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Link 7		Link 8		Link 9		Total		Lee Creek Variation	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.1	0.0	0.0
Cultivated Crops	1.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.1	11.1	0.0	0.0	0.0	0.0	2.0	0.2	63.9	2.1	0.0	0.0
Deciduous Forest	113.8	56.1	45.7	44.6	305.5	35.7	10.0	38.7	25.0	46.3	67.3	12.5	47.0	13.1	3.9	7.7	197.8	22.1	813.7	26.4	63.2	75.6
Developed, Low Intensity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.7	9.8	1.8	1.3	0.4	0.0	0.0	3.8	0.4	15.3	0.5	0.0	0.0
Developed, Medium Intensity	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0
Developed, Open Space	11.1	5.5	1.2	1.1	14.8	1.7	0.5	1.8	1.0	1.9	17.1	3.2	8.2	2.3	1.2	2.4	27.6	3.1	82.6	2.7	0.0	0.0
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.3	0.0	0.0	0.0	0.0	0.6	0.1	2.0	0.1	0.0	0.0
Evergreen Forest	1.6	0.8	0.0	0.0	41.1	4.8	1.6	6.0	5.2	9.7	32.0	5.9	107.3	29.8	6.9	13.7	209.6	23.4	404.7	13.1	9.5	11.4
Grassland/Herbaceous	13.1	6.4	6.7	6.5	37.4	4.4	0.0	0.0	1.0	1.9	1.3	0.2	1.4	0.4	0.0	0.0	16.6	41.9	77.5	2.5	3.0	3.6
Mixed Forest	11.3	5.6	0.9	0.9	17.9	2.1	5.5	21.3	4.9	9.2	5.6	1.0	22.8	6.3	2.3	4.6	44.1	4.9	115.1	3.7	6.2	7.4
Open Water	6.0	3.0	0.0	0.0	0.8	0.1	0.0	0.0	0.0	0.0	0.7	0.1	0.0	0.0	0.0	0.0	0.9	0.1	8.3	0.3	0.4	0.5
Pasture/Hay	38.6	19.0	46.4	45.2	428.2	50.0	8.3	32.2	15.9	29.7	328.5	60.8	169.2	47.1	35.8	71.6	368.2	41.1	1,436.1	46.6	0.0	0.0
Shrub/Scrub	4.5	2.2	1.8	1.7	8.5	1.0	0.0	0.0	0.0	0.0	0.3	0.1	1.9	0.5	0.0	0.0	23.2	2.6	40.1	1.3	0.8	1.0
Woody Wetlands	0.6	0.3	0.0	0.0	2.4	0.3	0.0	0.0	0.0	0.0	13.3	2.5	0.5	0.1	0.0	0.0	2.4	0.3	19.1	0.6	0.5	0.6
Total	203.0	100.0	102.6	100.0	865.5	100.0	25.8	100.0	53.3	100.0	540.0	100.0	359.6	100.0	50.0	100.0	896.7	100.0	3,081.8	100.0	83.5	100.0

Source: Jin et al. (2013)

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Table 3.10-19:
Land Cover in the Applicant Proposed Route—Region 5

Land Cover	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Link 7		Link 8		Link 9		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.0	0.8	0.0	4.8	1.4	8.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	14.9	0.5
Cultivated Crops	0.0	0.0	0.0	2.4	12.8	1.5	0.0	0.0	5.4	1.5	1.0	0.9	0.0	0.0	0.0	0.0	130.0	26.0	149.3	5.4
Deciduous Forest	102.7	34.2	48.9	31.1	260.0	31.3	68.3	19.4	132.9	38.0	18.7	17.1	58.1	48.2	16.4	41.2	106.4	21.3	810.8	29.4
Developed, High Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Developed, Low Intensity	0.0	0.0	0.8	0.5	2.1	0.3	2.0	0.6	1.9	0.5	1.2	1.1	0.0	0.0	0.0	0.0	5.4	1.1	13.5	0.5
Developed, Medium Intensity	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.6	2.3	0.7	1.6	1.4	0.2	0.2	0.0	0.0	2.7	0.5	10.5	0.4
Developed, Open Space	7.3	2.4	1.4	0.9	20.9	2.5	5.6	1.6	4.3	1.2	3.0	2.7	1.2	1.0	0.0	0.0	39.4	7.9	83.1	3.0
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Evergreen Forest	100.4	33.4	68.2	43.3	185.5	22.3	25.0	7.1	45.3	13.0	5.6	5.1	0.5	0.4	1.9	4.9	12.6	2.5	444.3	16.1
Grassland/ Herbaceous	11.0	3.7	4.9	3.1	27.4	3.3	11.6	3.3	12.5	3.6	0.0	0.0	2.7	2.2	1.3	3.3	7.2	1.4	78.5	2.8
Mixed Forest	20.9	7.0	21.1	13.4	48.2	5.8	27.1	7.7	35.4	10.1	28.6	26.2	27.1	22.5	13.7	34.4	80.6	16.1	301.1	10.9
Open Water	0.0	0.0	0.0	0.0	4.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	0.0	0.0	3.7	0.7	8.3	0.3
Pasture/Hay	53.7	17.9	12.1	7.7	248.6	29.9	198.8	56.5	87.7	25.1	41.4	37.9	30.3	25.1	6.4	16.2	96.4	19.3	773.4	28.1
Shrub/Scrub	4.2	1.4	0.0	0.0	17.4	2.1	6.7	0.0	13.3	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.6	1.5
Woody Wetlands	0.0	0.0	0.0	0.0	1.1	0.1	0.0	0.0	0.0	0.0	8.2	7.5	0.0	0.0	0.0	0.0	15.0	3.0	24.3	0.9
Total	300.1	100.0	157.6	100.0	830.4	100.0	352.1	100.0	349.9	100.0	109.2	100.0	120.0	100.0	39.8	100.0	499.9	100.0	2,753.8	100.0

Source: Jin et al. (2013)

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Table 3.10-20:
Land Cover in the Applicant Proposed Route—Region 6

Land Cover	Link 1		Link 2		Link 3		Link 4		Link 5		Link 6		Link 7		Link 8		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Cultivated Crops	127.1	84.7	39.2	94.3	198.3	84.1	140.9	90.6	43.6	94.4	238.3	60.0	193.2	92.3	80.3	83.4	1,056.5	79.6
Deciduous Forest	1.4	0.9	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	85.6	21.6	1.7	0.8	0.0	0.0	88.8	6.7
Developed, Low Intensity	0.5	0.3	0.0	0.0	0.0	0.0	0.4	0.3	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	1.3	0.1
Developed, Medium Intensity	0.0	0.0	0.0	0.0	1.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.1
Developed, Open Space	17.2	11.4	1.9	4.5	17.7	7.5	8.6	5.5	2.6	5.6	21.2	5.3	6.2	3.0	7.0	7.2	81.9	6.2
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.3	0.0	0.0	0.0	0.0	1.1	0.1
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.5	0.0
Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	1.9	0.0	0.0	0.0	0.0	7.7	0.6
Open Water	1.3	0.9	0.0	0.0	3.1	1.3	2.1	1.4	0.0	0.0	0.5	0.1	2.2	1.0	1.4	1.5	10.7	0.8
Pasture/Hay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.8	0.0	0.0	0.0	0.0	3.1	0.2
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	2.7	1.8	0.5	1.2	14.7	6.2	3.4	2.2	0.0	0.0	39.2	9.9	5.6	2.7	7.6	7.9	73.5	5.5
Total	150.1	100.0	41.6	100.0	235.7	100.0	155.5	100.0	46.2	100.0	397.1	100.0	209.4	100.0	96.3	100.0	1,326.9	100.0

Source: Jin et al. (2013)

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3.10.6.2.3.1.7 Region 7

The Applicant Proposed Route in Region 7 is approximately 43 miles long. Approximately 0.3 mile (0.6 percent) is parallel to existing transmission lines and 4 miles (9.4 percent) is parallel to existing roads. The land cover in the 200-foot representative ROW for Region 7 is listed in Table 3.10-21. The land cover in Region 7 is generally dominated by cultivated crops, although there is more variation than in Region 6. The land cover in the representative ROW consists of 691.8 acres (66.2 percent) cultivated crops, 86.8 acres (8.3 percent) of developed, open space, 79.1 acres (7.6 percent) of deciduous forest, 59.5 acres (5.7 percent) of woody wetlands, and 52.7 acres (5.0 percent) of shrub/scrub land. All other land cover types represent less than five percent of the total representative ROW.

Table 3.10-21:
Land Cover in the Applicant Proposed Route—Region 7

Land Cover	Link 1		Link 2		Link 3		Link 4		Link 5		Total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Cultivated Crops	545.2	78.1	16.5	61.5	59.3	35.6	19.1	49.5	52.6	44.5	691.8	66.2
Deciduous Forest	0.7	0.1	0.0	0.0	53.5	32.1	0.0	0.0	24.8	21.0	79.1	7.6
Developed, Low Intensity	3.6	0.5	0.0	0.0	2.3	1.4	0.0	0.0	2.0	1.7	7.8	0.7
Developed, Medium Intensity	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Developed, Open Space	67.8	9.7	10.3	38.5	2.5	1.5	0.7	1.7	6.1	5.1	86.8	8.3
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.6	0.4	0.0	0.0	0.0	0.0	0.6	0.1
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.9	1.1	0.1
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.3	1.5	0.1
Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.4	1.6	0.2
Open Water	26.2	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	2.5
Pasture/Hay	0.0	0.0	0.0	0.0	11.1	6.7	18.9	48.8	7.6	6.4	36.1	3.5
Shrub/Scrub	0.0	0.0	0.0	0.0	36.9	22.1	0.0	0.0	15.9	13.4	52.7	5.0
Woody Wetlands	54.1	7.8	0.0	0.0	0.2	0.0	0.0	0.0	5.2	4.4	59.5	5.7
Total	697.7	100.0	26.8	100.0	166.4	100.0	38.7	100.0	118.4	100.0	1,045.0	100.0

Source: Jin et al. (2013)

Two agricultural structures are present in the representative ROW for Applicant Proposed Route Link 5 and one other structure (type unknown) is present in the representative ROW for Link 1.

Outside the ROW, tensioning and pulling areas totaling approximately 162.4 acres would be required during construction and would be temporarily unavailable for other uses. The land cover in these areas is primarily cultivated crops. No existing structures are present in these areas.

3.10.6.2.3.2 Operations and Maintenance Impacts

Within the transmission line ROW (200 feet wide by 720 miles long), only the transmission structures would remain. For lattice structures, the operational footprint would be four to six structures per mile, and each foundation would measure 28 feet by 28 feet (less than 0.02 acre). Assuming 720 miles of lattice structures, the operational footprint would be 86 acres. Each structure would be 75 to 180 feet tall. For tubular pole structures, the operational footprint would be five to seven structures per mile, each 49 square feet, up to 5 acres total. Each structure would be 120 to 160 feet tall. Lattice crossing structures, which would be required in limited situations, would each have a structural footprint of 70 feet by 70 feet (approximately 0.11 acre). Guyed structures would also be required in limited situations, and would each have a structural footprint (not including guy wires) of 7 feet by 7 feet (0.001 acre). Impact calculations assumed lattice structures would be used for a conservative estimate of potential impacts.

The estimated 14 fiber optic regeneration sites would remain, each consisting of a fenced area 75 feet wide by 75 feet long (0.13 acre) including a control building 12 feet by 32 feet. A permanent access road to the fenced area, a power supply to the control building, and a backup power generator and fuel supply would also remain.

It is anticipated that all existing roads and existing roads with repairs/improvements would be retained for operations and maintenance of the Project. It is estimated that approximately 75 percent of the new overland roads with no improvements and 90 percent of the new overland roads with clearing and new bladed roads would be retained for operations and maintenance access. These roads would be up to 20 feet wide. Access roads that are not needed for operations and maintenance of the Project would be restored (GE-7).

All other land in the ROW could return to most previous land uses, primarily agriculture (grazing and crops). Land uses that would not be permitted in the ROW include buildings or structures, changes to grading and land contours, and some restrictions and coordination for infrastructure such as fences and irrigation lines. All of the tensioning and pulling areas could return to existing uses once construction has been completed.

During operations and maintenance, the ROW would be maintained according to a Transmission Vegetation Management Plan developed for the Project. Vegetation within the wire zone would be limited to low-growing grasses, legumes, herbs, crops, and shrubs where the conductor is 50 feet or less from the ground. Tall shrubs and short trees would be permitted in the border zone (i.e., to the edge of the ROW). Tree-trimming and brush removal would be conducted as needed to maintain the vegetation within the ROW.

During operations and maintenance, the transmission line would be inspected regularly and as necessary using fixed-wing aircraft, helicopters, ground vehicles, and/or personnel on foot. Maintenance would be performed as needed. Maintenance activities would generally be smaller in scale and more localized than construction activities. Maintenance activities may cause temporary impacts within the ROW such as damage to crops. Access would be restricted during the performance of maintenance activities.

Nearby residents would experience long-term visual impacts from the vegetation removed from the ROW and the permanent (until decommissioning) presence of the transmission structures and lines. Impacts to visual resources are discussed in more detail in Section 3.18.

The permanent impacts by region are summarized in Table 3.10-22 for pole structures. No permanent impacts are described for access roads, because the location of access roads has not yet been determined.

Table 3.10-22:
Impacts During the Operational Phase of the Applicant Proposed Route, by Region

Region	Length (miles)	Estimated Footprint of Structures (acres)*
1	116	16.2
2	106	14.8
3	162	22.7
4	126	17.6
5	113	15.8
6	54	7.6
7	43	6.0

*For a conservative estimate of impacts, the anticipated footprint of structures assumes seven lattice structures per mile; each would have a 28-foot by 28-foot foundation (less than 0.02 acre).

3.10.6.2.3.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning is complete, all land could return to the pre-construction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.3 Impacts Associated with the DOE Alternatives

This section discusses land use impacts for the DOE Alternatives, which include the Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area, the HVDC alternative routes and their associated access roads, multi-use construction yards and other temporary construction areas, and communications sites.

3.10.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.10.6.3.1.1 Construction Impacts

The land cover in the Arkansas Converter Station Alternative Siting Area consists of evergreen forest (36.1 percent), deciduous forest (24.8 percent), and pasture/hay (20.9 percent). Although the exact location of the converter station has not yet been determined, construction of this converter station would convert 40 to 50 acres of undeveloped land to a utility land use. An additional 5-10 acres would be required for construction only. These areas would be used as laydown areas for equipment during construction. An additional 4.2 acres of undeveloped land would be converted to access roads (2.4 acres permanent, 1.8 acres temporary).

The Arkansas AC interconnect would be approximately 6 miles long and during construction, approximately 146.5 acres of currently primarily pasture/hay land cover would be temporarily converted to an industrial use. Approximately 0.1 mile, or 2.2 percent of the route, would be parallel to existing roads. Table 3.10-23 lists the various types of land cover in the ROW, which is primarily composed of pasture/hay (65.7 aces, or 44.8 percent), evergreen forest (33.9 acres, or 23.1 percent), and deciduous forest (23.7 acres or 16.2 percent).

Table 3.10-23:
Land Cover in the Arkansas AC Interconnect ROW

Land Cover	Acres	%
Deciduous Forest	23.7	16.2
Developed, Low Intensity	1.1	0.8
Developed, Open Space	2.8	1.9
Evergreen Forest	33.9	23.1
Grassland/Herbaceous	2.8	1.9
Mixed Forest	11.0	7.5
Open Water	1.4	0.9
Pasture/Hay	65.7	44.8
Shrub/Scrub	2.4	1.6
Woody Wetlands	1.7	1.2
Total	146.5	100.0

Source: Jin et al. (2013)

A 5-acre site where the alternative AC transmission line would interconnect with an existing 500kV transmission line would be required, and an additional 5 acres would be temporarily required during the construction phase.

During construction, within the 146.5-acre ROW, assembly areas for the pole structures (either lattice or tubular structures) would be required, as well as tensioning and pulling sites. An assembly area 150 feet wide by 150 feet long for each structure would be required. Assuming five to seven structures per mile would be required, the assembly areas would take up between 15.5 and 21.7 acres within the ROW. Also within the ROW, approximately four tensioning and pulling sites 150 feet wide by 750 feet long would be required (2.6 acres each, for a total of 10.3 acres).

Outside of the ROW, an additional four tensioning and pulling sites of the same dimensions would be required (2.6 acres each, for a total of 10.3 acres).

Within the ROW, trees would need to be removed. Individual transmission structure sites would be cleared. Hand, mechanized, and chemical clearing may be used. Within or adjacent to the ROW for the transmission line, all trees would be removed. In the border zone adjacent to the ROW, some small trees may remain if they would not pose a risk of falling into the conductors.

3.10.6.3.1.2 Operations and Maintenance Impacts

After construction is complete, only the 40- to 50-acre converter station and 20-foot-wide paved access road would remain; all other temporary construction areas would be returned to their previous use, primarily rangeland. Approximately 40 acres would be fenced. A 5-acre site where the alternative AC transmission line would interconnect with the existing 500kV transmission line would also remain as a utility use.

Within the 6-mile-long Arkansas AC Interconnect ROW, only the pole structures would remain. For lattice structures, the operational footprint would be 5 to 7 structures per mile for five miles, or 25 to 35 structures total, each 28 feet by 28 feet (less than 0.02 acre), up to 0.7 acre total. For tubular structures, the operational footprint would be 5 to 7 structures per mile, or 25 to 35 structures total, each 7 feet by 7 feet (less than 0.1 acre), and less than 0.1 acre total.

All structures would be 75 to 180 feet tall. Access roads that are not needed for operations and maintenance of the Project would be restored. All other land in the ROW could return to previous land uses, except that only low-growing vegetation would be permitted in the ROW. Short trees (up to 25 feet in height at maturity) would be permitted adjacent to the ROW. Land uses that would not be permitted in the ROW include buildings or structures, changing the grading and land contours, and some restrictions and coordination for infrastructure such as fences and irrigation lines. Access would be restricted during the performance of maintenance activities.

3.10.6.3.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once decommissioning has been completed, all land could return to the pre-construction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.3.2 HVDC Alternative Routes

This section discusses the potential impacts within the 200-foot-wide representative ROWs of the HVDC alternative routes during the construction, operations and maintenance, and decommissioning phases of the Project.

3.10.6.3.2.1 Construction Impacts

Construction impacts would be similar to those discussed for the Applicant Proposed Route (Section 3.10.6.2.3.1). The ROW would be temporarily unavailable for existing uses during construction at a specific location.

Construction would begin with clearing and grading for access roads, pole structure sites and assembly areas, wire splicing sites, and tensioning and pulling sites. These areas would not be available for agricultural use during construction at a specific location. Within the ROW, trees would need to be removed. Individual transmission structure sites would be cleared Hand, mechanized, and chemical clearing may be used. For tensioning and pulling sites, clearing would be limited to the removal of larger woody vegetation or dense brush that may interfere with tensioning equipment; grading would also be limited to what is necessary to provide temporary access for tensioning equipment.

Within or adjacent to the ROW for the transmission line, all trees would be removed. In the border zone adjacent to the ROW, some small trees may remain if they would not pose a risk of falling into the conductors.

3.10.6.3.2.1.1 Region 1

Table 3.10-24 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 1. Each route is discussed in more detail below.

Table 3.10-24:
Land Cover in the HVDC Alternative Routes—Region 1

Land Cover	AR 1-A		AR 1-B		AR 1-C		AR 1-D	
	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	288.9	9.6	122.5	9.7	146.8	11.5	113.2	13.8
Deciduous Forest	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Developed, High Intensity	0.5	0.0	0.0	0.0	0.0	0.0	1.3	0.2
Developed, Low Intensity	2.1	0.1	6.8	0.5	8.5	0.7	1.0	0.1

Table 3.10-24:
Land Cover in the HVDC Alternative Routes—Region 1

Land Cover	AR 1-A		AR 1-B		AR 1-C		AR 1-D	
	Acres	%	Acres	%	Acres	%	Acres	%
Developed, Medium Intensity	2.9	0.1	0.1	0.0	0.1	0.0	3.5	0.4
Developed, Open Space	299.7	10.0	164.1	12.9	136.0	10.7	86.9	10.6
Evergreen Forest	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	2,265.4	75.4	86.6	69.9	892.3	70.1	568.9	69.4
Open Water	5.9	0.2	0.0	0.0	0.0	0.0	0.3	0.0
Shrub/Scrub	123.9	4.1	88.3	7.0	87.3	6.9	40.2	4.9
Woody Wetlands	8.5	0.3	0.0	0.0	1.6	0.1	3.9	0.5
Total	3,003.1	100.0	1,268.4	100.0	1,272.5	100.0	819.2	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.1.1 *Alternative Route 1-A*

HVDC Alternative Route 1-A is approximately 123 miles long and corresponds to Applicant Proposed Route Links 2, 3, 4, and 5. Approximately 5 miles (4.1 percent) would be parallel to existing transmission lines, compared to 1.7 miles (1.4 percent) for the corresponding links of the Applicant Proposed Route. Approximately 9 miles (7.0 percent) would be parallel to existing roads, compared to 8 miles (7.0 percent) for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 2,265 acres or 75.4 percent). Approximately 168 acres (6 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-A has more grasslands and school trust lands than the Applicant Proposed Route. Thirteen agricultural structures, four industrial structures, one commercial structure, one abandoned structure, and one other structure (use unknown) are present in the representative ROW, whereas in the corresponding links of the Applicant Proposed Route, one commercial structure and one agricultural structure are in the representative ROW.

Outside the ROW, tensioning and pulling areas totaling approximately 165 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is grassland/herbaceous. Approximately 11 acres of school trust lands would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 1-A.

3.10.6.3.2.1.1.2 *Alternative Route 1-B*

HVDC Alternative Route 1-B is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2 and 3. Approximately 0.1 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, which is comparable to the corresponding links of Applicant Proposed Route. Approximately 2 miles, or 3.4 percent of the route, would be parallel to existing roads, which is less than half of that for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 887 acres or 69.9 percent), similar to Link 3. Approximately 52 acres (4 percent of the representative ROW) has school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-B has more school trust lands than the corresponding links of the Applicant Proposed Route. One agricultural structure is present in the representative ROW, whereas no structures are present in the corresponding links of the Applicant Proposed Route (Links 2 and 3).

Outside the ROW, tensioning and pulling areas totaling approximately 46 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover in these areas is grassland/herbaceous. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 1-B.

3.10.6.3.2.1.1.3 *Alternative Route 1-C*

HVDC Alternative Route 1-C is approximately 52 miles long and corresponds to Applicant Proposed Route Links 2 and 3. Approximately 0.1 mile, or 0.2 percent of the route, would be parallel to existing transmission lines, which is less than the corresponding links of the Applicant Proposed Route. Approximately 2 miles (4.3 percent) would be parallel to existing roads, which is less than half of that for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 892 acres or 70.1 percent). Approximately 9 acres (less than 1 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-C has more cultivated crops, developed, and open space and less school trust land than the corresponding links of the Applicant Proposed Route. Seven agricultural structures and two industrial structures are present in the representative ROW, whereas no structures are present in the corresponding links of the Applicant Proposed Route (Links 2 and 3).

Outside the ROW, tensioning and pulling areas totaling approximately 60 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. Approximately 3 acres of school trust lands would be temporarily unavailable for existing uses. No structures are present in the tensioning and pulling areas for Alternative Route 1-C.

3.10.6.3.2.1.1.4 *Alternative Route 1-D*

HVDC Alternative Route 1-D is approximately 34 miles long and corresponds to Applicant Proposed Route Links 3 and 4. Approximately 0.2 mile, or 0.5 percent of the route, would be parallel to existing transmission lines, compared to 1.4 miles for the corresponding links of the Applicant Proposed Route. The land cover within the ROW is primarily grassland/herbaceous (approximately 569acres or 69.4 percent). Approximately 54 acres (7 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture or oil/gas development. HVDC Alternative Route 1-D has comparable land cover but more school trust lands than the corresponding links of the Applicant Proposed Route. Three residences and three agricultural structures are present in the representative ROW, whereas one commercial structure and one agricultural structure are present in Link 4 of the Applicant Proposed Route.

Outside the ROW, tensioning and pulling areas totaling approximately 29 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 1-D.

3.10.6.3.2.1.2 Region 2

Table 3.10-25 presents the land cover in the representative ROW for each of the two HVDC alternative routes in Region 2. Each alternative route is discussed in more detail below.

Table 3.10-25:
Land Cover in the HVDC Alternative Routes—Region 2

Land Cover	AR 2-A		AR 2-B	
	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.5	0.0	0.1	0.0
Cultivated Crops	311.6	22.3	440.3	60.5
Deciduous Forest	55.4	4.0	14.6	2.0
Developed, Low Intensity	11.2	0.8	1.0	0.1
Developed, Medium Intensity	3.0	0.2	0.0	0.0
Developed, Open Space	69.5	5.0	22.6	3.1
Evergreen Forest	89.1	6.4	2.0	0.3
Grassland/Herbaceous	833.5	59.7	240.0	33.0
Open Water	5.6	0.4	7.0	1.0
Pasture/Hay	2.6	0.2	0.0	0.0
Shrub/Scrub	14.3	1.0	0.0	0.0
Total	1,396.3	100.0	727.7	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.2.1 *Alternative Route 2-A*

HVDC Alternative Route 2-A is approximately 57 miles long and corresponds to Applicant Proposed Route Link 2. Approximately 0.2 mile, or 0.4 percent of the route, would be parallel to existing transmission lines, compared to 0.9 mile for Link 2. Approximately 3 miles (4.9 percent) would be parallel to existing roads, compared to 2 miles for Link 2.The land cover within the representative ROW is primarily grassland/herbaceous (approximately 834 acres or 59.7 percent). Approximately 23 acres (2 percent of the representative ROW) are school trust lands that would be temporarily unavailable for existing uses, primarily agriculture and oil/gas development. HVDC Alternative Route 2-A has more grasslands but fewer cultivated crops and school trust lands than Link 2. Two industrial structures and three agricultural structures are present in the representative ROW, whereas one commercial structure and two industrial structures are present in the representative ROW for the Applicant Proposed Route Link 2.

Outside the ROW, tensioning and pulling areas totaling approximately 84 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous followed by cultivated crops. Approximately 5 acres of school trust lands would be temporarily unavailable for other uses. No structures are present in the tensioning and pulling areas for Alternative Route 2-A.

3.10.6.3.2.1.2.2 *Alternative Route 2-B*

HVDC Alternative Route 2-B is approximately 30 miles long and corresponds to Applicant Proposed Route Link 3. Less than 0.1 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, which is comparable to Link 3. Approximately 1.5 miles (4.9 percent) of the route would be parallel to existing roads, which is comparable to Link 3.The land cover within the representative ROW is primarily cultivated crops (approximately 440 acres or 60.5 percent). HVDC Alternative Route 2-B has more cultivated crops but less developed open space than Link 3. One commercial structure and two industrial structures are present in the representative ROW, whereas two agricultural structures and one commercial structure are present in the representative ROW for the Applicant Proposed Route Link 3.

Outside the ROW, tensioning and pulling areas totaling approximately 31 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 2-B.

3.10.6.3.2.1.3 Region 3

Table 3.10-26 presents the land cover in the representative ROW for each of the five HVDC alternative routes in Region 3. Each alternative route is discussed in more detail below.

Table 3.10-26:
Land Cover in the HVDC Alternative Routes—Region 3

Land Cover	AR 3-A		AR 3-B		AR 3-C		AR 3-D		AR 3-E	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.3	0.0	1.7	0.1	0.0	0.0	0.0	0.0
Cultivated Crops	150.4	16.4	181.5	15.6	145.5	4.9	53.5	5.6	0.0	0.0
Deciduous Forest	187.7	20.4	219.0	18.8	869.2	29.3	184.3	19.2	74.1	35.7
Developed, Low Intensity	0.0	0.0	3.2	0.3	3.7	0.1	1.6	0.2	0.0	0.0
Developed, Medium Intensity	0.5	0.1	0.8	0.1	2.3	0.1	1.8	0.2	1.3	0.6
Developed, Open Space	64.1	7.0	71.2	6.1	89.9	3.0	32.7	3.4	8.1	3.9
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	2.2	0.1	0.0	0.0	0.0	0.0
Evergreen Forest	6.6	0.7	10	0.9	9.1	0.3	0.7	0.1	0.0	0.0
Grassland/Herbaceous	497.3	54.1	645.2	55.3	1,061.2	35.8	188.9	19.7	23.2	11.2
Open Water	7.6	0.8	7.7	0.7	8.7	0.3	3.6	0.4	2.8	1.3
Pasture/Hay	5.1	0.6	27.9	2.4	773.4	26.1	491.8	51.3	98.3	47.3
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0
Total	919.1	100.0	1,166.6	100.0	2,967.5	100.0	958.8	100.0	207.8	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.3.1 *Alternative Route 3-A*

HVDC Alternative Route 3-A is approximately 38 miles long and corresponds to Applicant Proposed Route Link 1. Approximately 0.3 mile, or 0.7 percent of the route, would be parallel to existing transmission lines, compared to 1.7 miles for Link 1. Approximately 2 miles (4.9 percent) of the route would be parallel to existing roads, compared to 3.1 miles for Link 1. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 497 acres or 54.1 percent) and deciduous forest (188 acres or 20.4 percent) and is comparable to Link 1. Three types of state land are present: 22 acres of Lake Carl Blackwell, 13 acres of Oklahoma State University land being used as research area, and 20 acres of school trust lands (use unknown), compared to 48 acres of Oklahoma State University land, and 33 acres of school trust lands in Link 1. These state land areas would be temporarily unavailable for other uses during construction in these locations. One agricultural structure is present in the representative ROW, whereas one industrial structure is present in the representative ROW for the Applicant Proposed Route Link 1.

Outside the ROW, tensioning and pulling areas totaling approximately 40 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. Approximately 0.2 acre of Lake Carl Blackwell and 6 acres of school trust lands (use unknown) are in these areas and would be temporarily unavailable for existing uses. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 3-A.

3.10.6.3.2.1.3.2 *Alternative Route 3-B*

HVDC Alternative Route 3-B is approximately 48 miles long and corresponds to Applicant Proposed Route Links 1, 2, and 3. Approximately 1.5 miles, or 3.1 percent of the route, would be parallel to existing transmission lines, which is comparable to the corresponding links of the Applicant Proposed Route. Approximately 2 miles (4.8 percent) would be parallel to existing roads, compared to 3.5 miles for Links 1, 2, and 3. The land cover within the representative ROW is primarily grassland/herbaceous (approximately 645 acres or 55.3 percent) and deciduous forest (219 acres or 18.8 percent) and is comparable to Links 1, 2, and 3. Three types of state land are present: 22 acres of Lake Carl Blackwell, 13 acres of Oklahoma State University land being used as research area, and 15 acres of school trust lands (use unknown), compared to 48 acres of Oklahoma State University land and 60 acres school trust lands in Links 1, 2, and 3. These areas would be temporarily unavailable for existing uses during construction in these locations. One commercial structure and two agricultural structures are present in the representative ROW, compared to one residence and one industrial structure in the representative ROW for the Applicant Proposed Route Links 1, 2, and 3.

Outside the ROW, tensioning and pulling areas totaling approximately 85 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is grassland/herbaceous. Approximately 0.2 acre of Lake Carl Blackwell and 6 acres of school trust lands (use unknown) are in these areas and would be temporarily converted to a utility use. One residence and two industrial structures in the tensioning and pulling areas for Alternative Route 3-B that may be affected by short-term effects from construction such as noise and dust.

3.10.6.3.2.1.3.3 *Alternative Route 3-C*

HVDC Alternative Route 3-C is approximately 122 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. Approximately 1 mile, or 0.8 percent of the route, would be parallel to existing transmission lines, comparable to the corresponding links of the Applicant Proposed Route. Approximately 6 miles (4.5 percent) of the route would be parallel to existing roads, comparable to Links 3, 4, 5, and 6. The land cover within the representative ROW is primarily composed of grassland/herbaceous (approximately 1,061 acres or 35.8 percent), deciduous forest (869 acres or 29.3 percent), and pasture/hay (773 acres or 26.1 percent) and is comparable to Links 3, 4, 5, and 6. Approximately 26 acres of school trust lands and 1 acre of Webbers Falls Lock and Dam and Reservoir would be temporarily unavailable for existing uses during construction at these locations, compared to 53 acres of school trust lands and 4.3 acres of Webbers Falls Lock and Dam and Reservoir in Links 3, 4, 5, and 6. Two residences, two industrial structures, one commercial structure, and six agricultural structures are present in the representative ROW, whereas two agricultural structures, one residence, and one industrial structure are present in the representative ROW for Links 3, 4, 5, and 6.

Outside the ROW, tensioning and pulling areas totaling approximately 221 acres would be required during construction and would be temporarily unavailable for other uses. The land cover is a mix of grassland/herbaceous, deciduous forest, and pasture/hay. Three residences are present in the tensioning and pulling areas for Alternative Route 3-C that may be affected by short-term effects from construction such as noise, dust, and access restrictions.

3.10.6.3.2.1.3.4 *Alternative Route 3-D*

HVDC Alternative Route 3-D is approximately 39 miles long and corresponds to Applicant Proposed Route Links 5 and 6. Approximately 0.5 mile, or 1.2 percent of the route, would be parallel to existing transmission lines, comparable to Links 5 and 6. Approximately 2 miles (4.8 percent) of the route would be parallel to existing roads, comparable to Links 5 and 6. The land cover within the representative ROW is primarily pasture/hay (approximately 492 acres or 51.3 percent) and deciduous forest and grassland/herbaceous (189 acres or 19.7 percent each) and is comparable to Links 5 and 6. Approximately 1 acre of Webbers Falls Lock and Dam and Reservoir would be temporarily unavailable for existing uses during construction at this location, compared to 4.3 acres in Links 3, 4, 5, and 6. Two residences and three agricultural structures are present in the representative ROW, whereas one residence and one agricultural structure are present in the representative ROW for the Applicant Proposed Route Links 5 and 6.

Outside the ROW, tensioning and pulling areas totaling approximately 82 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay, followed by deciduous forest. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 3-D.

3.10.6.3.2.1.3.5 *Alternative Route 3-E*

HVDC Alternative Route 3-E is approximately 9 miles long and corresponds to Applicant Proposed Route Link 6. Approximately 0.2 mile, or 2.4 percent of the route, would be parallel to existing transmission lines, comparable to Link 6. Approximately 0.6 mile (7.1 percent) of the route would be parallel to existing roads, comparable to Link 6. The land cover within the representative ROW is primarily pasture/hay (approximately 98 acres or 47.3 percent) and deciduous forest (74 acres or 35.7 percent), whereas Link 6 has a higher percentage of deciduous forest and grasslands. Approximately 1 acre of Webbers Falls Lock and Dam and Reservoir would be temporarily unavailable for existing uses during construction at this location, compared to 4.3 acres in Links 3, 4, 5, and 6. One residence is present in the representative ROW, whereas one agricultural structure is present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning and pulling areas totaling approximately 2 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 3-E.

3.10.6.3.2.1.4 Region 4

Table 3.10-27 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 4. Each alternative route is discussed in more detail below.

Table 3.10-27:
Land Cover in the HVDC Alternative Routes—Region 4

Land Cover	AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	1.5	0.1	0.0	0.0	0.0	0.0	0.8	0.1
Cultivated Crops	1.5	0.1	1.5	0.1	0.0	0.0	1.5	0.2	4.1	0.5
Deciduous Forest	624.0	43.8	873.2	45.5	32.4	39.2	179.6	29.1	121.6	13.6
Developed, Low Intensity	3.7	0.3	5.9	0.3	0.9	1.1	2.7	0.4	5.4	0.6

Table 3.10-27:
Land Cover in the HVDC Alternative Routes—Region 4

Land Cover	AR 4-A		AR 4-B		AR 4-C		AR 4-D		AR 4-E	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Developed, Medium Intensity	0.6	0.0	0.6	0.0	0.0	0.0	0.6	0.1	0.4	0.0
Developed, Open Space	29.6	2.1	46.3	2.4	1.1	1.4	14.3	2.3	37.9	4.2
Emergent Herbaceous Wetlands	1.4	0.1	0.9	0.0	0.0	0.0	0.9	0.1	0.0	0.0
Evergreen Forest	73.1	5.1	265.6	13.8	15.4	18.6	66.0	10.7	218.7	24.4
Grassland/Herbaceous	120.4	8.4	132.9	6.9	4.8	5.8	18.0	2.9	11.1	1.2
Mixed Forest	52.0	3.6	100.6	5.2	9.0	10.9	31.0	5.0	53.8	6.0
Open Water	0.6	0.0	2.1	0.1	0.0	0.0	0.3	0.0	0.0	0.0
Pasture/Hay	497.4	34.9	459.6	23.9	19.0	23.0	299.9	48.6	395.5	44.1
Shrub/Scrub	17.3	1.2	24.5	1.3	0.0	0.0	1.3	0.2	31.7	3.5
Woody Wetlands	4.3	0.3	4.7	0.2	0.0	0.0	1.4	0.2	16.2	1.8
Total	1,426.0	100.0	1,919.9	100.0	82.6	100.0	617.6	100.0	897.2	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.4.1 *Alternative Route 4-A*

HVDC Alternative Route 4-A is approximately 58 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. Approximately 0.2 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, compared to 0.9 mile for the corresponding links of the Applicant Proposed Route. Approximately 2.5 miles (4.4 percent) of the route would be parallel to existing roads, comparable to Links 3, 4, 5, and 6. The land cover within the representative ROW is primarily deciduous forest (approximately 624 acres or 43.8 percent) and pasture/hay (497 acres 34.9 percent), comparable to Links 3, 4, 5, and 6. Flood control dams constructed by NRCS are adjacent to this route as well as Link 3. Five residences and seven agricultural structures are present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning and pulling areas totaling approximately 189 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are pasture/hay and deciduous forest. No structures are present in these areas.

3.10.6.3.2.1.4.2 *Alternative Route 4-B*

HVDC Alternative Route 4-B is approximately 79 miles long and corresponds to Applicant Proposed Route Links 2–8. Less than 0.1 mile, or 0.1 percent of the route, would be parallel to existing transmission lines, compared to 1.2 miles for Links 2–8. Approximately 4 miles (5.5 percent) of the route would parallel existing roads, which is comparable to Links 2–8. The land cover within the representative ROW is primarily deciduous forest (approximately 873 acres or 45.5 percent) and pasture/hay (460 acres or 23.9 percent) and is generally comparable to Links 2–8.

Approximately 387 acres of the Ozark National Forest is within the representative ROW; 230 acres are federally owned and 157 acres are private land within the Ozark National Forest boundary (use unknown). This area also crosses the Ozark National Forest WMA, which shares a boundary with the National Forest. The AGFC regulates hunting in the WMA. Hunting could be temporarily disturbed in and near the ROW during construction (see Section 3.12 for further discussion of impacts to recreation). Whereas most areas within the ROW would only be temporarily unavailable for existing uses, any forested lands in the ROW would not be allowed to return to the existing use after construction is complete because timber would not be a permitted use within the ROW. The Applicant Proposed Route crosses approximately 2.5 acres of the USFS-managed Ozark National Forest and approximately 6 acres of state land (two WMAs) is present in Link 6. Eight residences, one industrial structure, and nine agricultural structures are present in the representative ROW, whereas three agricultural structures are present in the representative ROW for the Applicant Proposed Route Links 2–8.

The representative ROW crosses the southern boundary of the Ozark National Forest, where federal land and privately held land is a patchwork. The USFS has expressed several concerns regarding this alternative. According to the USFS, the ROW would create linear breaks in National Forest land and could adversely affect timber production. The USFS has also stated that, in places, HVDC Route Alternative 4-B would undermine the use for which the National Forest land was originally acquired, that is conservation of natural resources.

Outside the ROW, tensioning and pulling areas totaling approximately 199 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are deciduous forest and pasture/hay. Approximately 10 acres of federal land and 30 acres of private land in the Ozark National Forest boundary are within these areas and would be temporarily unavailable for existing uses during construction in these locations. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-B.

3.10.6.3.2.1.4.3 *Alternative Route 4-C*

HVDC Alternative Route 4-C is approximately 3 miles long and corresponds to Applicant Proposed Route Link 5. If this route is selected, 82.6 acres would be removed from existing uses. None of the route is parallel to existing transmission lines, and Link 5 is parallel to less than 0.1 mile of existing transmission line. Approximately 0.2 mile (6.4 percent) of the route is parallel to existing roads, compared to 0.1 mile for Link 5. Approximately 0.4 mile, or 11 percent of the route, would be parallel to existing infrastructure (within 50 feet) (transmission lines, pipelines, or roads), slightly more than Link 5.The land cover within the ROW is primarily deciduous forest (approximately 32.4 acres or 39.2 percent) and pasture/hay (19.0 acres or 23.0 percent) and is generally comparable to Link 5. One residence is present in the ROW, whereas no structures are present in the representative ROW for the Applicant Proposed Route Link 5.

Outside the ROW, tensioning and pulling areas totaling approximately 25.7 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are deciduous and evergreen forest. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-C.

3.10.6.3.2.1.4.4 *Alternative Route 4-D*

HVDC Alternative Route 4-D is approximately 25 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. Less than 0.1 mile, or 0.3 percent of the route, would be parallel to existing transmission lines, compared to 0.3 mile in the corresponding links of the Applicant Proposed Route. Approximately 1.4 miles (5.6 percent) of the route would parallel existing roads, compared to 2.1 miles for Links 4, 5, and 6. The land cover within the representative ROW is primarily pasture/hay (approximately 300 acres or 48.6 percent) and deciduous forest (180 acres or 29.1 percent), which is comparable to Links 4, 5, and 6. HVDC Alternative Route 4-D does not cross any federal or state land, whereas Link 6 crosses approximately 6 acres of state WMAs. Three residences, one church, and six agricultural structures are present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning and pulling areas totaling approximately 122 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are pasture/hay and deciduous forest. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-D.

3.10.6.3.2.1.4.5 *Alternative Route 4-E*

HVDC Alternative Route 4-E is approximately 37 miles long and corresponds to Applicant Proposed Route Links 8 and 9. Approximately 0.6, or 1.5 percent of the route, would be parallel to existing transmission lines, compared to 0.1 for Links 8 and 9. Approximately 3.7 miles (10.1 percent) of the route would parallel existing roads, compared to 2.5 miles for Links 8 and 9. The land cover within the representative ROW is primarily pasture/hay (approximately 396 acres or 44.1 percent) and evergreen forest (218.7 acres or 24.4 percent), comparable to Links 8 and 9. Two residences, one industrial structure, two agricultural structures, and two other structures (use unknown) are present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 9.

Outside the ROW, tensioning and pulling areas totaling approximately 147 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 4-E.

3.10.6.3.2.1.5 Region 5

Table 3.10-28 presents the land cover in the representative ROW for each of the six HVDC alternative routes in Region 5. Each alternative route is discussed in more detail below.

Table 3.10-28:
Land Cover in the HVDC Alternative Routes—Region 5

Land Cover	AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	2.2	0.1	1.6	0.7	0.0	0.0	2.0	0.2	3.2	0.6
Cultivated Crops	0.0	0.0	42.0	2.4	0.2	0.1	92.0	17.4	37.5	4.2	29.9	5.5
Deciduous Forest	78.8	25.4	479.5	27.7	99.9	44.5	246.5	46.5	249.3	28.2	153.2	28.1
Developed, High Intensity	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0
Developed, Low Intensity	0.0	0.0	9.4	0.5	0.5	0.2	1.3	0.2	4.7	0.5	2.0	0.4
Developed, Medium Intensity	0.0	0.0	0.1	0.0	0.1	0.0	1.9	0.3	0.1	0.0	0.0	0.0
Developed, Open Space	9.1	2.7	35.7	2.1	4.4	2.0	22.8	4.3	15.9	1.8	10.3	1.9
Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Evergreen Forest	130.4	42.6	211.7	12.2	5.0	2.2	28.1	5.3	81.8	9.2	67.4	12.4
Grassland/Herbaceous	13.1	5.1	79.2	4.6	10.7	4.8	22.2	4.2	46.2	5.2	18.6	3.4
Mixed Forest	17.4	5.7	113.0	6.5	30.6	13.6	63.8	12.0	63.9	7.2	49.8	9.2
Open Water	0.0	0.0	1.0	0.1	0.5	0.2	6.9	1.3	0.0	0.0	0.0	0.0
Pasture/Hay	53.6	17.1	740.3	42.7	70.9	31.6	30.4	5.7	383.5	43.3	209.9	38.6
Shrub/Scrub	6.2	1.3	14.0	0.8	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0

Table 3.10-28:
Land Cover in the HVDC Alternative Routes—Region 5

Land Cover	AR 5-A		AR 5-B		AR 5-C		AR 5-D		AR 5-E		AR 5-F	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Woody Wetlands	0.0	0.0	4.3	0.2	0.3	0.1	13.4	2.5	0.1	0.0	0.1	0.0
Total	308.5	100.0	1,732.3	100.0	224.6	100.0	529.6	100.0	885.1	100.0	544.5	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.5.1 *Alternative Route 5-A*

HVDC Alternative Route 5-A is approximately 13 miles long and corresponds to Applicant Proposed Route Link 1. The route would not be parallel to any transmission lines, and neither would Link 1. Approximately 0.9 mile (6.9 percent) of the route would be parallel to existing roads, compared to 0.7 mile for Link 1. The land cover within the representative ROW is primarily composed evergreen forest (130.4 acres or 42.3 percent) and deciduous forest (78.8 acres or 25.5 percent), comparable to Link 1. No structures are present in the representative ROW of HVDC Alternative Route 5-A, as is the case for the Applicant Proposed Route Link 1.

Outside the ROW, tensioning and pulling areas totaling approximately 65 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are deciduous and evergreen forests. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-A.

3.10.6.3.2.1.5.2 *Alternative Route 5-B*

HVDC Alternative Route 5-B is approximately 71 miles long and corresponds to Applicant Proposed Route Links 3, 4, 5, and 6. Approximately 0.2 mile (0.3 percent) of the route would be parallel to existing transmission lines, compared to 0.3 mile for the corresponding links of the Applicant Proposed Route. Approximately 3.3 miles (4.7 percent) of the route would be parallel to existing roads, compared to 3.7 miles for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily pasture/hay (740.3 acres or 42.7 percent) and deciduous forest (479.5 acres or 27.7 percent), compared to Links 3, 4, 5 and 6. Three residences, two industrial structures, and one agricultural structure are present in the representative ROW, whereas two abandoned structures and one other structure are present in the representative ROW for the Applicant Proposed Route Links 4, 5, and 6.

Outside the ROW, tensioning and pulling areas totaling approximately 221 acres would be required during construction and would be temporarily unavailable to other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-B.

3.10.6.3.2.1.5.3 *Alternative Route 5-C*

HVDC Alternative Route 5-C is approximately 9 miles long and corresponds to Applicant Proposed Route Links 6 and 7. Less than 0.1 mile, or 0.9 percent of the route, would be parallel to existing transmission lines, compared to 0.1 for Links 6 and 7. Approximately 0.4 mile (4.6 percent) would be parallel to existing roads, compared to 0.5 mile for Links 6 and 7. The land cover within the representative ROW is primarily deciduous forest (99.9 acres or 44.5 percent) and pasture/hay (70.9 acres or 31.6 percent), comparable to Link 7; the representative ROW for Link 6 has more mixed forest. One residence, one commercial structure, and one agricultural structure are present in the representative ROW, whereas one other structure (use unknown) is present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning and pulling areas totaling approximately 54 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land covers are pasture/hay and deciduous forest. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-C.

3.10.6.3.2.1.5.4 *Alternative Route 5-D*

HVDC Alternative Route 5-D is approximately 22 miles long and corresponds to Applicant Proposed Route Link 9. Less than 0.1 mile (0.2 percent) would be parallel to existing transmission lines, comparable to Link 9. Approximately 1.6 miles (7.3 percent) would be parallel to existing roads, compared to 1.9 miles for Link 9. The land cover within the representative ROW is primarily deciduous forest (246.5 acres or 46.5 percent) and cultivated crops (92.0 acres or 17.4 percent) compared to the representative ROW for Link 9, which has more cultivated crops. No structures are present in the representative ROW, as is the case in the Applicant Proposed Route Link 9.

Outside the ROW, tensioning and pulling areas totaling 89.3 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is deciduous forest. No existing structures are present in the tensioning and pulling areas for Alternative Route 5-D.

3.10.6.3.2.1.5.5 *Alternative Route 5-E*

HVDC Alternative Route 5-E is approximately 36 miles long and corresponds to Applicant Proposed Route Links 4, 5, and 6. Approximately 0.2 mile (0.5 percent) of the route would be parallel to existing transmission lines, comparable to the corresponding links of the Applicant Proposed Route. Approximately 1.6 miles (4.4 percent) of the route would be parallel to existing roads, comparable to Links 4, 5, and 6. The land cover within the representative ROW is primarily pasture/hay (383.5 acres or 43.3 percent) and deciduous forest (383.5 acres or 43.3 percent), comparable to the representative ROW for Links 4, 5, and 6. Three residences, one industrial structure, and one agricultural structure are in the representative ROW, whereas two abandoned structures and one other structure are present in the representative ROW for the Applicant Proposed Route Links 4, 5, and 6.

Outside the ROW, tensioning and pulling areas totaling 88.4 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 5-E.

3.10.6.3.2.1.5.6 *Alternative Route 5-F*

HVDC Alternative Route 5-F is approximately 22 miles long and corresponds to Applicant Proposed Route Links 5 and 6. Approximately 0.1 mile (0.6 percent) of the route would be parallel to existing transmission lines, compared to 0.2 mile for Links 5 and 6. Approximately 1.2 miles (5.4 percent) of the route would be parallel to existing roads, compared to 1.1 miles for Links 5 and 6. The land cover within the representative ROW is primarily pasture/hay (209.9 acres or 38.6 percent) and deciduous forest (153.2 acres or 28.1 percent), comparable to Links 5 and 6. Two residences are present in the representative ROW, whereas one abandoned structure is present in the representative ROW for the Applicant Proposed Route Link 5 and one other structure is present in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning and pulling areas totaling 52.1 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is pasture/hay. No structures are present in the tensioning and pulling areas for Alternative Route 5-F.

3.10.6.3.2.1.6 Region 6

Table 3.10-29 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 6. The land cover for all the routes is primarily cultivated crops. Each alternative route is discussed in more detail below.

Table 3.10-29:
Land Cover in the HVDC Alternative Routes—Region 6

Land Cover	AR 6-A		AR 6-B		AR 6-C		AR 6-D	
	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	328.6	83.0	272.1	79.2	410.6	72.6	205.3	91.8
Deciduous Forest	0.0	0.0	0.0	0.0	40.3	7.1	0.0	0.0
Developed, Low Intensity	1.6	0.4	1.3	0.4	0.2	0.0	0.0	0.0
Developed, Medium Intensity	0.0	0.0	0.7	0.2	0.5	0.1	0.0	0.0
Developed, Open Space	21.8	5.5	19.6	5.7	39.6	7.0	2.9	1.3
Emergent Herbaceous Wetlands	0.0	0.0	1.4	0.4	0.0	0.0	0.0	0.0
Evergreen Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Forest	0.0	0.0	0.0	0.0	12.2	2.2	4.0	1.8
Open Water	17.6	4.4	4.1	1.2	20.2	3.6	2.0	0.9
Pasture/Hay	0.0	0.0	0.0	0.0	20.0	3.5	0.0	0.0
Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Woody Wetlands	26.1	6.6	44.6	13.0	22.1	3.9	9.4	4.2
Total	395.7	100.0	343.7	100.0	565.6	100.0	223.6	100.0

Source: Jin et al. (2013)

3.10.6.3.2.1.6.1 *Alternative Route 6-A*

HVDC Alternative Route 6-A is approximately 16 miles long and corresponds to Applicant Proposed Route Links 2, 3, and 4. None of the route would be parallel to existing transmission lines, compared to 0.1 mile in Links 2, 3, and 4. Approximately 1.6 miles (10.0 percent) of the route would be parallel to existing roads, compared to 1.4 miles for the corresponding links of the Applicant Proposed Route. The land cover within the representative ROW is primarily composed of cultivated crops (328.6 acres or 83.0 percent), comparable to the corresponding links of the Applicant Proposed Route. One residence is present in the representative ROW, whereas one agricultural structure is present in the representative ROW for the Applicant Proposed Route Link 4.

Outside the ROW, tensioning and pulling areas totaling 62.5 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for Alternative Route 6-A.

3.10.6.3.2.1.6.2 *Alternative Route 6-B*

HVDC Alternative Route 6-B is approximately 14 miles long and corresponds to Applicant Proposed Route Link 3. Approximately 0.1 mile (0.9 percent) of the route would be parallel to existing transmission lines, whereas there are no existing transmission lines parallel to the Applicant Proposed Route Link 3. Approximately 1.8 miles (12.4 percent) would be parallel to existing roads, compared to 0.9 mile for Link 3. The land cover within the representative ROW is primarily cultivated crops (272.1 acres or 79.2 percent) and woody wetlands (44.6 acres or 13 percent) compared to 80.7 percent cultivated crops and 3.9 percent woody wetlands in Link 3. One residence is present in the representative ROW, whereas no structures are present in the representative ROW for the Applicant Proposed Route Link 3.

Outside the ROW, tensioning and pulling areas totaling 32.3 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for Alternative Route 6-B.

3.10.6.3.2.1.6.3 *Alternative Route 6-C*

HVDC Alternative Route 6-C is approximately 23 miles long and corresponds to Applicant Proposed Route Links 6 and 7. Approximately 0.1 mile (0.5 percent) of the route would be parallel to existing transmission lines, comparable to Links 6 and 7. Approximately 2.5 miles (10.7 percent) of the route would be parallel to existing roads, compared to 4.3 miles for Links 6 and 7. The land cover within the representative ROW is primarily cultivated crops (410.6 acres or 72.6 percent), comparable to the Applicant Proposed Route Links 6 and 7, although Link 6 has more deciduous forest and woody wetlands. HVDC Alternative Route 6-C does not cross any federal or state land, compared to the Applicant Proposed Route Link 7 which crosses approximately 0.5 acre of the Singer Forest Natural Area. One agricultural structure is present in the representative ROW, whereas four agricultural structures in the representative ROW for the Applicant Proposed Route Link 6.

Outside the ROW, tensioning and pulling areas totaling 50.7 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for Alternative Route 6-C.

3.10.6.3.2.1.6.4 *Alternative Route 6-D*

HVDC Alternative Route 6-D is approximately 9 miles long and corresponds to Applicant Proposed Route Link 7. The route would not be parallel to any existing transmission lines, like Link 7. Approximately 0.2 mile (2.5 percent) of the route would be parallel to existing roads, compared to 0.7 mile in the Applicant Proposed Route Link 7. The land cover within the representative ROW is primarily cultivated crops (205.3 acres or 91.8 percent) similar to Link 7. HVDC Alternative Route 6-D does not cross any federal or state land, whereas the Applicant Proposed Route Link 7 crosses approximately 0.5 acre of the Singer Forest Natural Area. No structures are present in the representative ROW, as is the case with the representative ROW for the Applicant Proposed Route Link 7.

Outside the ROW, tensioning and pulling areas totaling 17.8 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for Alternative Route 6-D.

3.10.6.3.2.1.7 Region 7

Table 3.10-30 presents the land cover in the representative ROW for each of the four HVDC alternative routes in Region 7. Each alternative route is discussed in more detail below.

Table 3.10-30:
Land Cover in the HVDC Alternative Routes—Region 7

Land Cover	AR 7-A		AR 7-B		AR 7-C		AR 7-D	
	Acres	%	Acres	%	Acres	%	Acres	%
Barren Land (Rock/Sand/Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cultivated Crops	827.8	78.7	86.4	41.2	350.6	53.5	76.8	48.1
Deciduous Forest	0.5	0.0	42.7	20.3	58.4	10.1	15.1	9.4
Developed, Low Intensity	5.7	0.5	0.6	0.3	6.2	1.1	1.4	0.9
Developed, Medium Intensity	0.1	0.0	0.0	0.0	0.9	0.1	0.0	0.0
Developed, Open Space	89.8	8.5	12.6	6.0	20.4	3.5	3.6	2.3
Emergent Herbaceous Wetlands	1.7	0.2	0.0	0.0	4.2	0.7	1.2	0.8
Evergreen Forest	0.0	0.0	0.9	0.4	2.6	0.5	0.0	0.0
Grassland/Herbaceous	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Forest	0.0	0.0	0.0	0.0	1.4	0.2	1.0	0.6
Open Water	14.9	1.4	0.0	0.0	0.0	0.0	0.0	0.0
Pasture/Hay	1.0	0.1	34.0	16.2	72.2	12.5	32.2	20.2
Shrub/Scrub	0.0	0.0	32.7	15.6	49.6	8.6	20.6	12.9
Woody Wetlands	110.5	10.5	0.0	0.0	12.1	2.1	7.7	4.8
Total	1,052.0	100.0	209.9	100	578.6	100	159.5	100

Source: Jin et al. (2013)

3.10.6.3.2.1.7.1 *Alternative Route 7-A*

HVDC Alternative Route 7-A is approximately 43 miles long and corresponds to Applicant Proposed Route Link 1. Approximately 0.2 mile (0.4 percent) of the route would be parallel to existing transmission lines, comparable to the Applicant Proposed Route Link 1. Approximately 3.7 miles (8.5 percent) of the route would be parallel to existing roads, compared to 2.7 miles for Link 1. The land cover within the representative ROW is primarily cultivated crops (827.8 acres or 78.7 percent) and woody wetlands (110.5 acres or 10.5 percent), similar to the Applicant Proposed Route Link 1, although the latter has slightly less woody wetlands and more developed open space. No structures are present in the representative ROW, whereas one “other” structure (use not known) is present in the representative ROW for the Applicant Proposed Route Link 1.

Outside the ROW, tensioning and pulling areas totaling 166 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 7-A.

3.10.6.3.2.1.7.2 *Alternative Route 7-B*

HVDC Alternative Route 7-B is approximately 9 miles long and corresponds to Applicant Proposed Route Links 3 and 4. The route would not be parallel to any existing transmission lines, comparable to the Applicant Proposed Route Links 3 and 4. Approximately 1.4 miles (16.0 percent) of the route would be parallel to existing roads, compared to 0.3 mile in the Applicant Proposed Route Links 3 and 4. The land cover within the representative ROW is primarily cultivated crops (86.4 acres or 41.2 percent), deciduous forest (42.7 acres or 20.3 percent), pasture/hay (34.0 acres or 16.2 percent), and shrub/scrub (32.7 acres or 15.6 percent), similar to the Applicant Proposed Route Links 3 and 4, although Link 4 has no deciduous forest. One residence is present in the representative ROW, whereas no structures are present in the representative ROW for the Applicant Proposed Route Links 3 and 4.

Outside the ROW, tensioning and pulling areas totaling 54 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 7-B.

3.10.6.3.2.1.7.3 *Alternative Route 7-C*

HVDC Alternative Route 7-C is approximately 24 miles long and corresponds to Applicant Proposed Route Links 3, 4, and 5. Approximately 0.7 miles (3.0 percent) of the route would be parallel to existing transmission lines, compared to less than 0.1 mile in the corresponding links of the Applicant Proposed Route. Two miles (8.4 percent) of the route would be parallel to existing roads, compared to 0.7 mile for Links 3, 4, and 5. The land cover within the representative ROW is primarily cultivated crops (350.6 acres or 60.6 percent), pasture/hay (72.2 acres or 12.5 percent), and deciduous forest (58.4 acres or 10.1 percent), whereas the Applicant Proposed Route Links 3, 4, and 5 have more deciduous forest and shrub/scrub. One residence is present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 5.

Outside the ROW, tensioning and pulling areas totaling approximately 112 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures are present in the tensioning and pulling areas for HVDC Alternative Route 7-C.

3.10.6.3.2.1.7.4 *Alternative Route 7-D*

HVDC Alternative Route 7-D is approximately 7 miles long and corresponds to Applicant Proposed Route Links 4 and 5. Approximately 0.1 mile (0.8 percent) of the route would be parallel to existing transmission lines, compared to less than 0.1 mile in the Applicant Proposed Route Links 4 and 5. Approximately 0.3 mile (4.7 percent) of the route would be parallel to existing roads, compared to 0.4 mile for the Applicant Proposed Route Links 4 and 5. The land cover within the representative ROW is primarily cultivated crops (76.8 acres or 48.1 percent), pasture/hay (32.2 acres or 20.2 percent), and shrub/scrub (20.6 acres or 12.9 percent) and is generally comparable to the Applicant Proposed Route Links 4 and 5. No structures are present in the representative ROW, whereas two agricultural structures are present in the representative ROW for the Applicant Proposed Route Link 5.

Outside the ROW, tensioning and pulling areas totaling approximately 30 acres would be required during construction and would be temporarily unavailable for other uses. The predominant land cover is cultivated crops. No structures exist in the tensioning and pulling areas for HVDC Alternative Route 7-D.

3.10.6.3.2.2 Operations and Maintenance Impacts

Impacts from operations and maintenance of the HVDC alternative routes would be similar to those from the Applicant Proposed Route (see Section 3.10.6.2.3).The long-term impacts by region are summarized in Table 3.10-31 for pole structures. No long-term impacts are described for access roads, because the location of access roads has not yet been determined.

Table 3.10-31:
Impacts During the Operational Phase of the Alternative Routes

Region	Length (miles)	Estimated Footprint of Structures (acres)[1]
Region 1		
1-A	123	17.2
1-B	52	7.3
1-C	52	7.3
1-D	34	4.8
Region 2		
2-A	57	8.0
2-B	30	4.2
Region 3		
3-A	38	5.3
3-B	48	10.9
3-C	122	17.0
3-D	39	5.5
3-E	8.5	1.2
Region 4		
4-A	58	8.1
4-B	79	11.1
4-C	3	0.4
4-D	25	3.5
4-E	37	5.2
Region 5		
5-A	13	1.8
5-B	71	9.9
5-C	9	1.3
5-D	22	3.1
5-E	36	5.0
5-F	22	3.1
Region 6		
6-A	16	2.2
6-B	14	2.0
6-C	23	3.2
6-D	9	1.3
Region 7		
7-A	43	6.0
7-B	9	1.3
7-C	24	3.4
7-D	6.5	0.9

1 For a conservative estimate of impacts, the anticipated footprint of structures assumes seven lattice structures per mile; each would have a 28-foot by 28-foot foundation (less than 0.02 acre).

Although the majority of the land in the ROW could return to most previous uses, forested areas such as the ROW within the Lee Creek Variation in Region 4 of the Application Proposed Route or HVDC Alternative Route 4-B, which includes the Ozark National Forest, would not be permitted to return to timber production because trees could interfere with the reliability and safety of the HVDC facilities.

3.10.6.3.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning is complete, all land could return to the pre-construction land uses described in Section 3.10.4 and Section 3.10.5.

3.10.6.4 Best Management Practices

In addition to the EPMs described in Section 3.10.6.1 and Section 3.10.6.7, the following BMPs have been identified to avoid or minimize potential land use impacts:

- In existing forested areas where temporary work areas require tree clearing, replant temporary work areas with appropriate tree species.
- In addition to EPM LU-5, make reasonable efforts to avoid displacing structures on private property.

3.10.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts to land uses from the Project include the removal of vegetation and conversion of primarily rangeland and cultivated crops and some forested lands and developed open space to a utility use. The Applicant Proposed Route would result in the conversion of up to approximately 2,600 acres of land to utility use for the life of the Project, including 2,394 acres for access roads (assuming 90 percent of them will remain after construction), 120 acres for two converter stations, 86 acres for all pole structures, and 2 acres for fiber regeneration sites.

Under the Applicant Proposed Route, 31 structures are present in the representative ROW: two residences, three commercial structures, 18 agricultural structures, four industrial structures, two abandoned structures, and two other structures. These structures would have to be removed if the Project features could not avoid them. Yields from cultivated crops, pasture/hay, and timberlands would be temporarily affected in the construction areas, and uses that are incompatible with the operation of the transmission line, such as tall trees for timber, would be removed from the ROW for the life of the Project.

3.10.6.6 Irreversible and Irretrievable Commitment of Resources

The use of the approximately 2,600 acres for the life of the Project would be irreversible since some land use restrictions would result. Once the Project has been decommissioned, all land could return to previous uses; therefore, there would be no irretrievable commitment of land use resources.

3.10.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Local short-term use effects from the Project would result from the removal of vegetation and conversion of primarily agricultural and undeveloped land to a utility use. Other short-term and local impacts include the disruption to access to local land uses that may occur, such as agriculture, oil and gas development, and residences and businesses during construction.

The short-term impacts would be minimized, however, because of multiple EPMs incorporated into the Project (Appendix F).

EPMs that should ensure long-term productivity of during operations and maintenance of the Project include:

- Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). Clean Line will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems (AG-1).
- Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments (AG-2).
- Clean Line will consult with landowners and/or tenants to identify the location and boundaries of agriculture or conservation reserve lands and to understand the criteria for maintaining the integrity of these committed lands (AG-3).
- Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. Clean Line will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms (AG-4).
- Clean Line will stabilize slopes exposed by its activities to minimize erosion (GEO-1).

The use of native seed mixes and tree species when revegetating the ROW would increase the likelihood that native grasslands and forestlands would return to their previous conditions.

3.10.6.8 Impacts from Connected Actions

3.10.6.8.1 Wind Energy Generation

Based on the maximum capacity of the Project and information from wind energy developers[2], it is estimated that 20 to 30 percent of the potentially suitable land, or between 216,400 and 324,600 acres, would actually be developed for wind energy facilities using transmission capacity from the Project.

It is estimated that during the construction phase, approximately 2 percent of land within a wind energy facility is affected (Denholm et al. 2009). Assuming between 20 and 30 percent of the WDZs would be built out, between 4,328 and 6,492 acres would be temporarily disturbed (2 percent of the 20 percent for the low end, 2 percent of the 30 percent for the high end). This range includes the construction of access roads, turbine pads and foundations, underground collection lines, collector substation, and often a generation tie line. An operations and maintenance building and at least one or two meteorological towers are also typically included.

2 The Applicant requested confidential information from wind energy developers considering development in the region, including confidential information regarding project nameplate, and proposed general location.

During the operations and maintenance phase of wind energy facilities, approximately 1 percent or less of the land would be affected (Denholm et al. 2009). For the 12 WDZs, assuming 20 to 30 percent build-out, between 2,164 and 3,246 acres would be disturbed (until decommissioning). Once construction has been completed, temporary construction areas would revert to their previous use. Only turbines, access roads, generation tie-lines (if necessary), substations, and operations and maintenance buildings would remain. Existing land uses, primarily agriculture and grazing, would be expected to return to almost all areas of the facilities, unless deemed incompatible with the operation of a wind farm.

Wind turbines and associated facilities are typically located outside municipal boundaries and densely populated communities. The facilities are also typically micro-sited to accommodate the wishes of participating landowners, avoid affecting sensitive land uses, and to meet local zoning and other setback requirements, so most residences, businesses, cemeteries, churches, hospitals, and schools and other sensitive uses are expected to be avoided.

Temporary impacts during construction may include increased noise, dust, and traffic. Impacts to rangeland/pasture and cultivated crops would result from disturbing vegetation and soils. Construction would temporarily prevent the existing uses in the construction area, including growing crops and animal grazing. Wind energy developers typically coordinate with landowners to minimize impacts to agricultural operations, such as timing construction to begin after crops are harvested; installing fencing to prevent injuries to, or the loss of, livestock; and types of seed to use during revegetation.

Temporary impacts to transportation infrastructure, such as state and local roadways, as well as to aboveground and subsurface utilities, may occur during construction of wind energy facilities. Wind energy developers would be required to acquire the appropriate state and county permits for work in ROWs, and typically return roadways to the same or improved conditions. Wind energy developers also typically coordinate with landowners and operators of existing utilities to locate these utilities and avoid or minimize impacts to existing structures to the extent practicable.

Wind developers must comply with FAA regulations, including submitting planned turbine locations for approval and installing hazard navigation lighting. FAA would determine whether the turbine locations would compromise the operation of nearby airports. Regional airports and airstrips are identified in Section 3.16.

Wind lease agreements typically include provisions to minimize the losses, including minimizing soil compaction and revegetating temporary work areas. In addition, the agreements typically stipulate compensation for landowners for any losses, such as damage or loss of crops, gates, fences, landscaping and trees, irrigation, and livestock. Once construction is complete, agricultural operations would be able to continue in most of the wind farm. Agricultural activities such as cultivating crops and livestock grazing are generally permitted up to the wind turbine pads, so only a very minimal area of existing agricultural land would be permanently removed from production. Permanent access roads may change the configuration of fields for crops and grazing.

Oil and gas development could be temporarily affected during construction if access to drilling equipment is prevented. These and more direct impacts to drilling infrastructure are expected to be minimized through coordination with landowners. Once construction is complete, oil and gas development in the vicinity of the wind energy facilities could continue.

If a wind energy facility is developed on school trust lands, the existing uses may be temporarily reduced during construction, but may be able to continue once the wind energy facility is operating, depending on the terms of the lease.

Potential effects on hunting and recreation are discussed in Section 3.12. Potential effects on agriculture are discussed in Section 3.2. Potential effects on airports are discussed in Section 3.16.

3.10.6.8.2 Optima Substation

The future Optima substation is anticipated to be constructed on 160 acres of currently undeveloped land partially within the Oklahoma AC Interconnection Siting Area and near an operating wind energy facility. The land cover of the site is primarily grassland/herbaceous. This area would be converted to a utility use for the life of the Project.

3.10.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

Land uses in areas affected by the required TVA upgrades could include different distributions of land cover and development levels than described in Section 3.10.6 for the Project. The TVA upgrades, like the Project, are linear projects, with the exception of substation modifications, with relatively small amounts of ground disturbance considering the amount of area crossed, which tends to minimize the amount of land use changes on a regional basis. Also, once the construction is complete, much of the affected land could return to previous land uses such as agriculture (grazing and crops).

Potential land use impacts associated with the required upgrades to existing TVA facilities are not anticipated to result in significant effects to land use. The degree of potential impacts associated with the new electric transmission line would depend on the types of existing land uses within the 37-mile long transmission line ROW. The majority of the ROW would be disturbed during construction only for both the new transmission line and the upgrades to existing facilities. Areas of fully dedicated use (e.g., sites of converter stations, structures, and permanent access roads) would experience longer-term impacts than ROW areas, where existing land use may continue after construction, with certain limitations. Anticipated effects from upgrades to existing structures, conductor, or substations would be expected to include ground disturbance that is typically limited to the immediate vicinity of the structure, and no changes to the existing utility use.

3.10.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. No impacts on land uses on private, federal, state, or tribal lands, or their corresponding land management policies and regulations would occur. The existing land uses within the ROW would be expected to continue.

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Contents

Tables

3.11 Noise

This section presents the affected environment related to noise and addresses the potential noise impacts on noise sensitive areas (Noise Sensitive Areas [NSAs]; e.g., residences and schools) from the construction, operations, and decommissioning of the Project. The following subsections describe the regulatory background as it pertains to noise, discuss existing acoustic conditions, and assess potential noise impacts related to the Project.

3.11.1 Regulatory Background

This section describes noise regulations at the federal, state, and local level that may be applicable to the Project.

3.11.1.1 Federal

Two federal regulatory guidelines have been identified for assessing noise impacts from the Project. The EPA guidelines are applicable to operational and maintenance noise from the Project and the DOT guidelines are applicable to construction noise from the Project.

3.11.1.1.1 U.S. Environmental Protection Agency

In 1974, the EPA published a study that includes the only large database of community reaction to noise to which a project can be readily compared called Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (EPA 1974). The EPA has developed widely accepted recommendations for long-term exposure to environmental noise with the goal of protecting public health and safety; however, they are not regulatory limits. Instead, the study evaluates the effects of environmental noise with respect to health and safety, and provides information for state and local governments to use in developing their own ambient noise standards. For outdoor residential areas and other locations in which quiet is a basis for use, the recommended EPA guideline is 55 dBA (or decibels weighted on the A-scale) L_{dn}. The L_{dn} is calculated by averaging the 24-hour L_{eq} levels at a given location after adding 10 decibels to the nighttime period (10:00 p.m.–7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. For a steady 24-hour noise source such as a converter station, an L_{eq} of 48.6 dBA is equal to the L_{dn} criterion of 55 dBA. The EPA also suggests an L_{eq} (24) of 70 dBA (24-hour) limit to avoid adverse effects on public health and safety at publicly accessible property lines or extents of work areas where extended periods public exposure is possible. The EPA criteria are summarized in Table 3.11-1, which identifies levels of environmental noise below which there is no evidence that the general population would be at risk to EPA-identified health effects.

Table 3.11-1:
Summary of EPA Environmental Noise Guidelines

Location	Level	Effect
All public accessible areas with prolonged exposure	70 dBA $L_{eq(24)}$	Safety/Hearing loss
Outdoor at residential structure and other noise sensitive receptors where a large amount of time is spent	55 dBA L_{dn}	Outdoor activity interference and annoyance
Outdoor areas where limited amounts of time are spent, e.g., park areas, school yards, golf courses, etc.	55 dBA $L_{eq(24)}$	Outdoor activity interference and annoyance
Indoor residential	45 dBA L_{dn}	Indoor activity interference and annoyance
Indoor non-residential	55 dBA $L_{eq(24)}$	Indoor activity interference and annoyance

Source: EPA (1974)

3.11.1.1.2 U.S. Department of Transportation

The DOT has identified criteria for the assessment of short- and long-term construction activities for both stationary and mobile projects, and specifically for linear projects. The Federal Transit Administration (FTA) recommends abatement of construction noise that exceeds absolute noise levels at NSAs. These construction noise criteria take into account the diurnal pattern of construction activities, the absolute noise levels during construction activities, the duration of the construction, and adjacent land use. While these criteria were not developed to address construction noise impacts for power transmission line projects, the guidelines shown in Table 3.11-2 provide reasonable criteria for the construction noise assessment. If these criteria are exceeded, adverse community reaction may result.

Table 3.11-2:
DOT Guidelines for Construction Noise Assessment

Land Use	L_{eq}, 1-hr (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: FTA (2012)

3.11.1.2 State and Local

The states of Oklahoma, Arkansas, Tennessee, and Texas and the local jurisdictions to which DOE's Proposed Action is in proximity do not have environmental noise regulations with numerical decibel limits applicable to the Project. The EPA guideline of 55 dBA L_{dn}, has therefore been used in the evaluation potential noise impacts associated with the Project.

3.11.2 Data Sources

Data sources used in characterizing the existing acoustic environment and evaluating noise impacts are those provided in Table 3.11-3.

Table 3.11-3:
Noise Analysis Data Sources

Specific Noise Analysis	Data Source
Background sound levels	2011 National Land Cover Database used to characterize land use (e.g., mixed forest, developed land, agriculture, etc.) within the ROI. (GIS Data Source: Jin et al. 2013)
	USGS Topographic Maps (http://nationalmap.gov/ustopo/index.html) used to characterize land relief within the ROI.
	Federal Transit Administration High-Speed Ground Transportation Noise and Vibration Impact Assessment. (FTA 2012)
Predicted project sound levels	DOT Construction Noise Handbook. (FHWA 2006)
	Expected construction equipment is listed in the Project description (Appendix F). Construction sound source levels were obtained from FHWA. (2006)
	Expected operational equipment is listed in the Project description (Appendix F). Operational sound source levels were obtained from the Project Electrical Environment Assessment (Section 3.4 of this EIS).
Noise sensitive receptors	See Section 3.10 of this EIS.

3.11.3 Region of Influence

For noise, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.11.4 Affected Environment

The affected environment includes the NSAs in the ROI. As mentioned previously NSAs can include residences, and schools, etc. or other places where quiet is a basis for use. Locations of residences and schools are shown in Figure 1.0-2 located in Appendix A of the EIS. The only two schools within the ROI are within AC Collection System Route E-1, located within the town of Hardesty. Using the applicable noise thresholds for the various Project facilities as a guide, potentially impacted NSAs were identified in the ROI. Conversely for connected actions, some of the ROIs are not known at this time; therefore, potentially impacted NSAs will have to be identified when those ROIs have been defined.

3.11.5 Regional Description

Chapter 2 of this EIS includes detailed descriptions of the routing alternatives broken down by seven geographic regions, or Regions 1 through 7. Construction and operational noise sources vary by region and generally differ based on specific Project components as listed in Section 2.1. Access road construction would be required to construct and maintain the Project components regardless of region. Chapter 2 describes each region and Section 3.10 describes land uses within the ROI.

3.11.5.1 Connected Actions

3.11.5.1.1 Wind Energy Generation

The WDZs are all located within the Oklahoma Panhandle and the adjacent portions of Texas, so the regional description is the same as that of Region 1.

3.11.5.1.2 Optima Substation

The future Optima Substation is partially located within the Oklahoma AC Interconnection Siting Area. There are no NSAs located within 0.75 mile from the future Optima Substation.

3.11.5.1.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.11.6 Noise Impacts

Noise impacts from the Project are classified as temporary impacts associated with construction and permanent impacts associated with operations and maintenance of the Project.

3.11.6.1 Methodology

Sound is described as a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure creating a sound wave. Sound energy is characterized by the properties of sound waves, which include frequency, wave length, period, amplitude, and velocity. Noise is highly subjective and defined as unwanted sound. It is largely dependent on its magnitude and/or intensity of the sound source, its duration, the proximity of noise-sensitive land uses, and the time of day the noise occurs (i.e., higher sensitivities would be expected during the quieter overnight periods).

The range of frequencies that humans hear can span from 20 to 20,000 Hz; however, humans have varying sensitivities to noise at different frequencies, even though the energy content is the same. The amplitude of a sound wave is measured in terms of its sound pressure level where a logarithmic decibel scale is used. The A-weighting filter attenuates low and high frequency energy to simulate the hearing response of the human auditory system. Sound levels that are A-weighted to reflect human response are designated as dBA.

To take into account sound fluctuations, environmental noise is commonly described in terms of the L_{eq}. The L_{eq} value, conventionally expressed in dBA, is the energy-averaged, A-weighted sound level for the time period of interest. It is defined as the steady, continuous sound level, over a specified time, which has the same acoustic energy as the actual varying sound levels over that same time period. Another common noise descriptor used when assessing environmental noise is the L_{dn}, which includes the addition of 10 dB to noise emitted during the nighttime period (10:00 p.m. to 7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. The maximum sound level (L_{max}) is the maximum instantaneous sound level as measured during a specified time period. It can also be used to quantify the time-varying maximum instantaneous sound pressure level (as generated by equipment or an activity) or a manufacturer maximum source emission level.

An acoustic analysis was conducted for Project construction and operations and maintenance using criteria and guidelines discussed in Section 3.11.1. The analysis methods included determining a threshold distance from Project construction and operations and maintenance activities for the converter stations, Applicant Proposed Route, AC collection system, and HVDC alternative routes. Each threshold distance correlated with a selected noise criterion; therefore, an NSA located within a threshold distance would experience received sound levels in excess of that criterion.

The analysis of operational noise (long-term impacts) from the converter stations, Applicant Proposed Route, AC collection system, and HVDC alternative routes, was based on a representative centerline as described in Section 3.1. Construction noise (short-term impacts) threshold distances were calculated by generating a composite, or summed, noise level for all construction equipment required for a certain construction phase. Sound attenuation calculations were then completed to determine the distance from the Project ROW at which construction noise would decrease to levels corresponding to the DOT construction noise thresholds. Once this distance was determined, the number of NSAs within that distance from Project construction activities was quantified. The DOT construction noise thresholds were used to determine the threshold distances, which includes a daytime $L_{eq(1\text{-}hr)}$ 90 dBA threshold and a nighttime $L_{eq(1\text{-}hr)}$ 80 dBA threshold, both applicable at residential land uses. A similar methodology was used to evaluate potential noise impacts associated with Project operations, but the EPA 55 dBA L_{dn} noise guideline was used to determine the threshold distance. Threshold distances would vary greatly depending on the Project activity. For instance, during the construction phase, heightened received sound levels would result from use of heavy equipment and helicopters, whereas noise associated with transmission line operation (termed corona noise) would be substantially lower. Where impacts were identified, noise mitigation measures were recommended. The Applicant has developed a comprehensive list of EPMs that will aid in minimizing noise impacts. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for noise impacts are listed below:

- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-17: Clean Line will consider noise and radio/television interference in the design of bundle configurations and conductors. To minimize noise and radio/television interference, the Applicant will maintain tension on insulator assemblies and protect the conductor surface from damage during construction.
- GE-20: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-25: Clean Line will turn off idling equipment when not in use.

3.11.6.2 Impacts Associated with the Applicant Proposed Project

Impacts include those from construction, operations and maintenance, and decommissioning of the converter stations, AC transmission lines, and HVDC transmission lines. Construction noise levels would be temporary, lasting 32 months for the Applicant Proposed Project; however, construction would last for much shorter durations of several days to weeks in any given area for the AC transmission lines and HVDC transmission lines and up to 12 months for construction of each converter station. Temporary construction noise can be a source of annoyance for NSAs located nearby and is characterized as a short-term impact. Operational noise is generally lower level but long term in nature and characterized as a long-term impact. The following sections describe construction and operations and maintenance noise impacts expected for the converter stations, AC transmission lines, and HVDC transmission lines.

3.11.6.2.1 Converter Stations

The Applicant Proposed Project includes two proposed converter stations in Oklahoma and Tennessee. Potential noise impacts associated with construction, operations and maintenance, and decommissioning of the converter stations are discussed in the following subsections.

3.11.6.2.1.1 Construction Impacts

Construction of the proposed converter stations would be completed in three stages: site preparation, foundation installation, and erection of the station. Because detailed design has not been completed to date, representative converter station sites were used within the converter station siting areas, located approximately where the HVDC and AC connector lines meet. Each converter station site is assumed to be approximately 50 acres in size for the purposes of this analysis. Construction of the converter stations would require the short-term use of heavy equipment such as cranes, loaders, bulldozers, graders, excavators, compressors, generators, and various trucks. Pile driving is not expected during construction. Construction noise is usually made up of intermittent peaks and continuous lower levels of noise from equipment cycling through use. Noise levels associated with individual pieces of equipment at 50 feet away would generally range between 55 and 85 dBA L_{max} (FHWA 2006). Maximum instantaneous construction noise levels would range from 91 to 95 dBA L_{eq} at 50 feet from any work site. Table 3.11-4 provides noise level data for the three converter station construction stages; the highest construction noise levels are associated with erecting the stations. Predicted L_{eq} values are given at several reference distances to provide an indication of sound levels generated during the various converter station construction stages and how those levels attenuate with distance.

Using the construction stage anticipated to generate the highest noise level (erecting of station), the threshold distance to the DOT construction noise thresholds described in Section 3.11.1 using the methodology described in Section 3.11.6.1, was calculated from each converter station construction area. The threshold distances were determined to be 95 feet and 275 feet for the daytime (90 dBA L_{eq}) and nighttime (80 dBA L_{eq}) thresholds, respectively, so any NSAs located within those distances to the construction areas would potentially experience an exceedance of the DOT guidelines. Review of aerial mapping used to identify NSAs near the analyzed converter station areas indicates that no NSAs would be located within either of these threshold distances, so no exceedances of the DOT guidelines are expected.

Table 3.11-4:
Construction Noise Levels—Converter Stations

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
Site Preparation	Scrapers	4	85	40	93	87	81	75	67
	Bulldozer	2	85	40					
	Motor Grader	2	85	40					
	Roller Compacter	2	80	20					
	Excavator	2	85	40					
	Dump Trucks	4	84	40					
	Water Truck	3	84	20					
	Mechanic's Truck	1	84	20					
	Fuel Truck	1	84	20					
	Pick-up Truck	2	55	40					
Foundation Installation	Boom Trucks	2	85	40	91	85	79	73	65
	Excavator	1	85	40					
	Concrete Trucks	3	85	40					
	Dump Truck	1	85	40					
	Roller Compactor	1	85	20					
	Plate Compactor	2	80	20					
	Backhoe	1	80	40					
	Bobcats	2	70	40					
	Mechanics' Truck	1	84	20					
	Fuel Truck	1	84	20					
	Water Truck	1	84	20					
	Pick-up Truck	2	55	40					
Erecting of Station	Pick-up Truck	6	55	40	95	89	83	77	69
	Truck (2-ton)	6	84	40					
	Truck (1-ton)	3	84	40					
	Forklift (Telescopic)	6	85	40					
	Fuel Truck	1	84	20					
	Boom Lift	6	85	20					

Table 3.11-4:
Construction Noise Levels—Converter Stations

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
	Crane (15-ton Boom Truck)	3	85	40					
	Crane (30-ton)	3	85	40					
	Crane (120- to 300-ton)	3	85	20					
	Welder Truck	6	55	20					
	Air Compressor	3	80	20					
	Generator	3	82	40					

3.11.6.2.1.2 Operations and Maintenance Impacts

Noise generated from operations and maintenance of the converter stations was analyzed. Converter station maintenance activities are expected to require minimal equipment such as trucks and lifts, which would not generate much noise. Because of the nature of the equipment likely needed for maintenance and the periodic basis that maintenance would be conducted, noise levels associated with converted station maintenance are expected to be low at nearby NSAs.

As mentioned above, detailed design of the converter stations has not been completed at this stage of permitting. Typical equipment that would be installed at the converter stations would include AC filters, coolers, converter valves, chillers, reactors, capacitors, and transformers. The principal noise sources in the converter stations are the transformers with second and third highest sound sources being the filter reactors and valve coolers, respectively.

Converter station noise would propagate and attenuate at different rates depending on the locations and specifications of sound producing equipment. For example, the sound generated by transformers depends on several factors including the transformer size, voltage rating, and design. Table 3.11-5 provides the equipment type, quantity, and sound power level used in assessing noise generated during converter station operation.

Table 3.11-5:
Converter Station Equipment Noise Sources

Equipment Type	Quantity	Sound Power (dBA)
AC Filters	12	77
Filter Capacitor	12	82
Filter Reactor	12	95
Converter Transformers	12	112
Coolers	6	88
Smoothing Reactors	2	72
Valve Coolers	2	92
Chillers	2	77
Converter Valves	2	82

Both converter stations share the same equipment types, quantities, and sound power levels. To the extent practicable, the Applicant would orient the converter stations such that the noisiest side of the station, the AC side, is facing away from the nearest NSA. In addition, sound from the converter station transformers would be partially mitigated by barrier walls on three sides of the transformers each exceeding the transformer height. The valve hall building would be acoustically insulated with metal outer sheeting.

Acoustic modeling was conducted using the information provided in Table 3.11-5 implementing the general configuration planned for the converter stations. The model used was Datakustik's CadnaA version 3.7.124 implementing the International Organization for Standardization standard 9613-2, Acoustics—Attenuation of Sound During Propagation Outdoors (ISO 1996). The engineering methods specified in this standard consist of full octave band algorithms that incorporate geometric spreading due to wave divergence, reflection from surfaces, atmospheric absorption, screening by topography and obstacles, ground effects, source directivity, heights of sources and receptors (i.e., NSAs), seasonal foliage effects, and meteorological conditions. The following subsections provide the results of this acoustic modeling analysis.

3.11.6.2.1.2.1 Oklahoma Converter Station Siting Area and AC Interconnection Siting Area

The analysis conducted for the Oklahoma converter station showed that the predicted sound level at the nearest NSA, located 7,000 feet from the center point of the converter station, inclusive of the assumed background sound level of 43 dBA (L_{dn}), is 48 dBA L_{dn}, which is below the EPA environmental noise guideline of 55 dBA L_{dn}. It should be noted that final design of the converter station has not been completed. Based on the analysis, however, compliance with the EPA noise guideline is expected and NSAs located further away are expected to experience lower sound levels, so no noise impacts are anticipated at the Oklahoma converter station.

The Oklahoma converter station includes one 5-mile 345kV interconnection line. No NSAs are located within the threshold distance for 345kV single circuit transmission lines as described in Section 3.11.6.2.2 and using the methodology described in Section 3.11.6.1.

3.11.6.2.1.2.2 Tennessee Converter Station Siting Area and AC Interconnection Siting Area

The analysis conducted for the Tennessee converter station showed that the predicted converter station sound level at the nearest NSA, located 1,400 feet from the center point of the converter station, inclusive of the assumed background sound level of 43 dBA (L_{dn}), is 51 dBA L_{dn}, which is below the EPA environmental noise guideline of 55 dBA L_{dn}. It should be noted that final design of the converter station has not been completed. Based on the analysis, however, compliance with the EPA noise guideline is expected and NSAs located further away are expected to experience lower sound levels, so no noise impacts are anticipated at the Tennessee converter station.

The Tennessee converter station would include relatively short distance (less than 1 mile in length) 500kV AC transmission interconnection lines. No NSAs are located within the applicable threshold distance for 500kV single circuit transmission lines as described in Section 3.11.6.2.2 and using the methodology described in Section 3.11.6.1.

3.11.6.2.1.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction. Because no impacts are expected from construction of the Project, and because sound levels with decommissioning would be similar, no impacts are expected from decommissioning.

3.11.6.2.2 AC Collection System

Potential noise impacts associated with the AC collection system for construction and operations and maintenance are discussed in the following subsections.

3.11.6.2.2.1 Construction Impacts

Construction of the AC transmission lines would be completed in stages such as ROW clearing, foundation installation, structure assembly, and conductor stinging. Construction of the AC transmission lines would occur as a series of sequential events distributed over several miles along the transmission line route at any one time. Noise levels associated with individual pieces of equipment at 50 feet would generally range between 55 and 103 dBA L_{max} (FHWA 2006). Maximum instantaneous construction noise levels would range from 88 to 96 dBA L_{eq} at 50 feet from any work site. Table 3.11-6 provides noise level data for the four stages of AC transmission line construction; the highest construction noise levels would be associated with structure assembly and conductor stringing. Similar to data provided for converter station construction, sound levels generated during transmission line construction are provided at a set of reference distances.

It is likely that blasting would be required for some tower installations; however, in these cases, a detailed Blasting Plan would be developed and implemented to avoid noise impacts.

Table 3.11-6:
Construction Noise Levels—AC Collection Lines

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
ROW Clearing	Bulldozer	1	85	40	88	82	76	70	62
	Chipper	1	75	40					
	Excavator	1	85	40					
	Feller Buncher	1	75	40					
	Flail Mower or Bush Hog	1	84	40					
	Hydra-Ax or Mulcher	1	84	40					
	Loader	1	80	40					
	Pick-up Trucks	4	55	40					
	Skidder	1	85	40					
Foundation	Bobcat	1	70	40	91	85	79	73	65
	Bulldozer	1	85	40					
	Concrete Trucks	3	85	40					
	Cranes (20-ton)	2	85	16					
	Drill Rig	1	84	20					
	Dump Truck	1	84	40					
	Excavator	1	85	40					
	Generator	1	82	50					

Table 3.11-6:
Construction Noise Levels—AC Collection Lines

Stage	Construction Equipment	Quantity	Reference Noise Level L_{max} at 50 feet	Usage Factor (%)	Composite Sound Pressure Level (L_{eq}) at Distance from Sound Source				
					50 feet	100 feet	200 feet	400 feet	1,000 feet
	Loader	1	80	40					
	Pick-up Truck	3	55	40					
	Plate Compactor	1	80	20					
	Truck (1-ton)	1	84	40					
	Wagon Drill	1	85	20					
Structure Assembly	3-drum pullers (heavy)	2	85	16	96	90	84	78	70
	3-drum pullers (medium)	1	82	50					
	Helicopter (large)	1	103	20					
	Cranes (20-ton)	4	55	40					
	Crane (30-ton)	1	85	40					
	Double Bull-Wheel Tensioner (heavy)	1	85	40					
Conductor Stringing	3-drum pullers (heavy)	2	80	50	96	90	84	78	70
	3-drum pullers (medium)	2	80	50					
	Bulldozers	2	85	40					
	Cranes (20-ton)	2	85	16					
	Crane (30-ton)	1	85	16					
	Double Bull-Wheel Tensioner (heavy)	1	82	25					
	Double Bull-Wheel Tensioner (medium)	1	82	25					
	Helicopter (small)	1	97	50					
	Pick-up Truck	4	55	40					
	Single-Drum Puller (Large)	1	80	50					
	Splicing Trucks	2	55	40					
	Trucks (5-ton)	4	85	40					
	Wire Reel Trailers	6	85	20					

Source: FHWA (2006)

The calculated threshold distance from each AC transmission line construction area using the methodology in Section 3.11.6.1, was determined to be 100 feet and 325 feet for the daytime (90 dBA L_{eq}) and nighttime (80 dBA L_{eq}) thresholds, respectively. An analysis was conducted to evaluate the number of NSAs within these threshold distances from the transmission line for each transmission line alternative under consideration. The results of this analysis are provided below in Table 3.11-7 by alternative. While noise levels would be elevated during Project construction, noise impacts are considered short-term and temporary. The use of EPMs would aid in minimizing construction noise impacts.

Table 3.11-7:
Construction Noise Impacts for the AC Collection System by Route

Line Voltage/Structure	Number of NSAs within 100 feet	Number of NSAs within 325 feet
E-1	—	7
E-2	—	1
E-3	1	2
NE-1	—	5
NE-2	1	3
NW-1	—	11
NW-2	1	6
SE-1	—	1
SE-2	—	—
SE-3	1	3
SW-1	—	—
SW-2	—	—
W-1	—	5

GIS Data Sources: Clean Line (2013a); Tetra Tech (2014a)

3.11.6.2.2.2 Operations and Maintenance Impacts

Operations and maintenance impacts include those associated with the AC collection system. Maintenance would include the use of trucks, lifts, or other equipment as needed proximate to the converter stations on a periodic basis along the AC collection system.

The proposed AC transmission lines have the potential to emit noise under certain operating and environmental conditions. Transmission line noise (also called corona noise) is caused by the partial electrical breakdown of the insulating properties of air around the electrical conductors and overhead power lines as described in Section 3.4. When audible, corona-generated noise is often described as a raspy hum or buzz. Corona noise is primarily affected by weather and (to a lesser degree) by altitude and temperature. Audible corona noise from transmission lines occurs primarily in foul weather. Foul weather is a weather condition when there is precipitation or high humidity present that can cause the transmission-line conductors to be wet. In addition, while fog is not a form of precipitation it may cause conductors to be wet. Dry snow, conversely, is a form of precipitation, but it may not cause the conductors to be wet (EPRI 2005). Water droplets on the conductors act as electric field concentrators, and produce a large number of corona discharges, each of them creating a burst of noise. During fair weather conditions, corona noise levels are typically low and often confined to occurrences of scratches or other imperfections on the conductor surface or where dust has settled on the line. Corona activity increases with increasing altitude, and with increasing voltage in the line, but is generally not affected by system loading.

Sound levels emitted from transmission lines are related to line voltage. Audible noise calculations for the AC transmission lines were performed as described in Section 3.4. The methods used to calculate audible noise from transmission lines were developed by DOE, specifically by the Bonneville Power Administration (BPA), and have been validated and used by engineers and scientists for many years. The inputs to the model include such parameters as line voltage, load flow (current), altitude, meteorological conditions, the physical dimensions of the line, conductor diameter, spacing, and height of the conductors and receivers above ground level. The BPA method of calculating audible noise from transmission lines is based on long-term statistical data collected from operating and test transmission lines. This method calculates the L_{50} noise level during rainy conditions of 1 millimeter per hour or more up to 5 millimeters per hour, at which point the sound of rain hitting the ground, foliage, and/or structures masks the audible noise from the line (BPA 1991).

Potential noise impacts resulting from operation of the AC transmission lines were assessed assuming conditions that would generate the highest noise emissions. These conditions are when the conductors are wet and the AC line is at its highest altitude for the proposed alignments, approximately 3,000 feet. The audible noise results were then used to determine threshold distances using the methodology described in Section 3.11.6.1, corresponding to the 55 dBA L_{dn} EPA guideline threshold, for the proposed 345kV and 500kV lines. The threshold distance for the 335kV line was calculated to be 146 feet and the threshold distance for the 500kV line was calculated to be 659 feet. The 500kV lines are required to connect the converter stations to the existing AC grid. A noise impact is assumed to occur if an NSA is located within the identified threshold distances.

All AC collection system routes were analyzed to determine potential noise impacts associated with operation. Of all of the routes under consideration, the only ones with NSAs located within the threshold distance of 146 feet were AC Collection System Routes E-3 and NE-2. Both of these alternatives showed one NSA that would be located within the 146-foot distance corresponding to the EPA guideline threshold of 55 dBA L_{dn} for a transmission line of 345kV line voltage. Therefore, there is the potential that both of those NSAs may experience adverse noise impacts from transmission line operation if those alternatives are constructed; however, impacts would be less under different weather conditions or if the transmission line is located at an altitude less than 3,000 feet.

3.11.6.2.2.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction.

3.11.6.2.3 HVDC Applicant Proposed Route

HVDC transmission lines have the potential to result in noise impacts during the construction, operations and maintenance, and decommissioning phases of the Project. The following sections describe the expected impacts from construction and operations and maintenance of the Applicant Proposed Route.

3.11.6.2.3.1 Construction Impacts

Construction impacts from the Applicant Proposed Route would be similar to those sound levels associated with constructing the AC collection system lines. The main difference with construction of the HVDC lines is that construction would cover a much larger area, spanning from the panhandle of Oklahoma through Arkansas and into eastern Tennessee. Project construction of HVDC lines is also expected to last 32 months. Construction would last for much shorter durations of several days to weeks in any given area of HVDC transmission lines. The construction process for HVDC transmission lines would be the same as that for the AC collection lines for which noise levels are provided in Table 3.11-6.

It is likely that blasting would be required for some tower installations; however, in these cases a detailed Blasting Plan would be developed and implemented to avoid or minimize noise impacts.

The Applicant Proposed Route was analyzed using the methodology described in Section 3.11.6.1 to identify NSAs that would be within the nighttime DOT guideline threshold of 80 dBA, a threshold distance of 325 feet, and to the daytime DOT guideline threshold of 90 dBA, a threshold distance of 100 feet. Table 3.11-8 provides the number of NSAs located within these threshold distances by region. The NSAs located within these threshold distances may experience short-term and temporary elevated noise levels during Project construction; the implementation of EPMs would minimize construction noise impacts.

Table 3.11-8:
Construction Noise Impacts for the Applicant Proposed Route by Region

Line Voltage/Structure	Number of NSAs within 100 feet	Number of NSAs within 325 feet
Applicant Proposed Route—Region 1	1	7
Applicant Proposed Route—Region 2	1	15
Applicant Proposed Route—Region 3	6	78
Applicant Proposed Route—Region 4	12	107
Applicant Proposed Route—Region 5	2	47
Applicant Proposed Route—Region 6	6	24
Applicant Proposed Route—Region 7	2	28

3.11.6.2.3.2 Operations and Maintenance Impacts

Operations and maintenance impacts include those associated with maintaining the operability of the HVDC transmission lines. Maintenance would include the use of trucks, lifts, or other equipment as needed proximate to the converter stations on a periodic basis along the AC collection system.

The HVDC transmission lines have the potential to emit environmental noise under certain operating and environmental conditions referred to as corona noise. Unlike AC lines, HVDC transmission lines emit higher noise levels under fair weather conditions than under foul weather, although generally corona noise is lower for HVDC transmission lines in comparison to AC transmission lines of similar voltage operating under foul weather. The noise is lower because of the increased space charge around the transmission line conductors in foul weather, making the effective size of the conductor larger, which reduces the surface gradient and the audible noise produced. HVDC transmission lines, therefore, generate the highest noise emissions during fair weather conditions. Corona activity increases with increasing altitude, and with increasing voltage in the line, and is loudest in a single-polarity operation as opposed to bipolar operation. Negligible audible noise results in a single-polarity negative operation. Section 3.4 discusses in detail the differences between AC transmission line and HVDC transmission line corona noise emissions and how the sound power levels were calculated for these sound sources.

For the purposes of assessing noise impacts at NSAs, conditions corresponding to the highest noise emissions were assumed. Audible noise calculations for the HVDC transmission lines were performed as described in Section 3.4. The audible noise results were then used to determine the threshold distance using the methodology described in 3.11.6.1, corresponding to the 55 L_{dn} EPA guideline for the proposed HVDC lines, which was a distance of 130 feet. Table 3.11-9 provides the number of NSAs within that threshold distance by region.

Table 3.11-9:
Operational Noise Impacts for the Applicant Proposed Route by Region

Line Voltage/Structure	Number of NSAs within 130 feet
Applicant Proposed Route—Region 1	—
Applicant Proposed Route—Region 2	—
Applicant Proposed Route—Region 3	2
Applicant Proposed Route—Region 4	—
Applicant Proposed Route—Region 5	—
Applicant Proposed Route—Region 6	—
Applicant Proposed Route—Region 7	—

3.11.6.2.3.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction.

3.11.6.3 Impacts Associated with DOE Alternatives

Methods to assess construction and operations and maintenance noise impacts for DOE Alternatives would be the same as described for the Applicant Proposed Route in Section 3.11.6.2.3. The difference is in the location of each alternative relative to nearby NSAs. The following sections describe the number of NSAs that would be impacted by each of the alternatives under consideration.

3.11.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

Construction, operations and maintenance, and decommissioning of the Arkansas converter station would result in increased noise levels nearby. Construction and operations and maintenance noise impacts are summarized in the following sections.

3.11.6.3.1.1 Construction Impacts

Using the construction stage (erecting of station) anticipated to generate the highest noise level and the methodology described in Section 3.11.6.1, the threshold distance to the DOT construction noise thresholds provided in Table 3.11-4 were calculated from the alternative converter station construction area. The threshold distances were determined to be 95 feet and 275 feet for the daytime (90 dBA L_{eq}) and nighttime (80 dBA L_{eq}) thresholds, respectively, so any NSAs located closer than those distances to the construction area would potentially experience an exceedance of the DOT guidelines. A review of aerial mapping conducted to identify NSAs near the analyzed alternative converter station indicates that no NSAs would be located within either of these threshold distances, so no exceedances of the DOT guidelines are expected.

3.11.6.3.1.2 Operations and Maintenance Impacts

The analysis conducted for the Arkansas converter station showed that the predicted converter station sound level at the nearest NSA, located 1,600 feet from the center point of the converter station, inclusive of the assumed background sound level of 43 dBA (L_{dn}), is 49 dBA L_{dn}, which is below the EPA environmental noise guideline of

55 dBA L_{dn}. NSAs located further away are expected to experience lower sound levels, so no noise impacts are anticipated at the Arkansas converter station.

In addition, the Arkansas converter station would include a relatively short distance (less than 5 miles in length) 500kV AC transmission interconnection lines. Six NSAs would be located within 659 feet of the Arkansas interconnection line, which using the methodology described in Section 3.11.6.1, corresponds to the threshold distance to the 500kV single circuit AC transmission line.

3.11.6.3.1.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long a time period as those associated with construction.

3.11.6.3.2 HVDC Alternative Routes

Construction and operations and maintenance of the HVDC alternative routes would result in increased noise levels nearby. Construction and operations and maintenance noise impacts are summarized in the following sections.

3.11.6.3.2.1 Construction Impacts

Construction impacts for the HVDC alternative routes were calculated using the same methods described for the Applicant Proposed Route. The following sections provide the number of NSAs that would be impacted by construction noise for each alternative by region. A noise impact is assumed to occur if an NSA is located within the identified threshold distances from the work site.

All proposed HVDC alternative routes were analyzed to determine the number of NSAs located within the threshold distance of 325 feet, which corresponds to the nighttime DOT guideline threshold of 80 dBA, and the number of NSAs located within the threshold distance of 100 feet, which corresponds to the daytime DOT guideline threshold of 90 dBA. Table 3.11-10 provides the number of NSAs located within these threshold distances by region and alternative. These NSAs may experience short-term and temporary elevated noise levels during Project construction. The implementation of EPMs would minimize construction noise impacts.

Table 3.11-10:
Construction Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure	Number of NSAs within 100 feet	Number of NSAs within 325 feet
AR 1-A	—	5
AR 1-B	—	1
AR 1-C	—	1
AR 1-D	6	11
AR 2-A	1	5
AR 2-B	—	3
AR 3-A	—	9
AR 3-B	1	19
AR 3-C	9	68

Table 3.11-10:
Construction Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure	Number of NSAs within 100 feet	Number of NSAs within 325 feet
AR 3-D	2	28
AR 3-E	1	9
AR 4-A	13	83
AR 4-B	18	86
AR 4-C	2	8
AR 4-D	5	43
AR 4-E	6	33
AR 5-A	1	9
AR 5-B	5	40
AR 5-C	1	6
AR 5-D	1	19
AR 5-E	5	18
AR 5-F	3	14
AR 6-A	1	4
AR 6-B	2	8
AR 6-C	1	14
AR 6-D	—	—
AR 7-A	0	13
AR 7-B	6	42
AR 7-C	6	53
AR 7-D	0	5

3.11.6.3.2.2 Operations and Maintenance Impacts

Operational and maintenance impacts discussed in this section include those associated with the HVDC alternative routes. The methods are the same as those used for the Applicant Propose Route. A noise impact is assumed to occur if an NSA is located within the identified threshold distances from the transmission line centerline. All HVDC alternative routes were analyzed to determine the number of NSAs located within the threshold distance of 130 feet, which corresponds to the EPA guideline threshold of 55 dBA L_{dn}. Table 3.11-11 provides the number of NSAs located within these threshold distances by region and alternative. These NSAs may experience adverse noise impacts from the HVDC alternative routes under certain operational and weather conditions.

Table 3.11-11:
Operational Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure	Number of NSAs within 130 feet
Region 1	
AR 1-A	—
AR 1-B	—
AR 1-C	—
AR 1-D	4

Table 3.11-11:
Operational Noise Impacts by HVDC Alternative Route and Region

Line Voltage/Structure	Number of NSAs within 130 feet
Region 2	
AR 2-A	—
AR 2-B	—
Region 3	
AR 3-A	—
AR 3-B	—
AR 3-C	3
AR 3-D	2
AR 3-E	1
Region 4	
AR 4-A	5
AR 4-B	10
AR 4-C	1
AR 4-D	4
AR 4-E	2
Region 5	
AR 5-A	—
AR 5-B	3
AR 5-C	1
AR 5-D	—
AR 5-E	3
AR 5-F	2
Region 6	
AR 6-A	1
AR 6-B	1
AR 6-C	—
AR 6-D	—
Region 7	
AR 7-A	—
AR 7-B	1
AR 7-C	1
AR 7-D	—

3.11.6.3.2.3 Decommissioning Impacts

Decommissioning noise impacts are expected to be similar to construction noise impacts because similar equipment would be required. However, decommissioning activities would take less time than construction activities, so NSAs would not experience decommissioning noise impacts for as long as those associated with construction.

3.11.6.4 Best Management Practices

In addition to the Applicant's EPMs, DOE has identified one BMP to address unavoidable noise impacts from the Project (Section 3.11.6.5 below). This BMP would involve the use of a communications program that is described in Section 3.1. Noise complaints from construction and/or operation of the Project would be handled via the Applicant's communications program.

3.11.6.5 Unavoidable Adverse Impacts

Unavoidable adverse impacts would result from operations and maintenance of the Project as described in Sections 3.11.6.2 and 3.11.6.3. Construction impacts, while a source of potential annoyance to nearby NSAs, would be temporary and avoided to the extent practicable via use of EPMs. Sound levels generated by the converter stations are not expected to exceed the EPA guidelines (e.g., 55 dBA L_{dn}) at nearby NSAs; however, the EPA guidelines would be exceeded at some NSAs from operations and maintenance of the proposed AC and HVDC transmission lines.

Impacts associated with AC collection system would be mainly associated with the operation of the line under foul weather conditions defined as being conditions where the line is saturated with water. These conditions typically occur when rain is of sufficient strength to saturate the line, an approximate rate of 1 millimeter/hour. Because people tend to remain indoors during foul weather, the likelihood of an impact occurring at NSAs diminishes because received sound levels indoors would generally be 10–20 dBA lower. Additionally, under foul weather conditions, ambient sound levels are typically higher because of rain impacting the ground, vegetation, and/or nearby structures. As a result, foul weather may partially or completely mask the sound of the AC transmission lines. The AC transmission line operations and maintenance noise impacts are therefore classified as being unavoidable, but not necessarily adverse.

Unlike AC transmission line noise, noise levels associated with HVDC transmission line operation are highest under fair weather conditions. The likelihood of people being outdoors during peak HVDC transmission line conditions is therefore more likely than with AC transmission lines. Additionally, because transmission lines are a sound source that is elevated above ground, typical mitigation options, such as noise barriers or berms, are not feasible. Impacts discussed in this EIS are associated with conditions corresponding to the highest noise emissions, so impacts are expected to be less during more typical operations and maintenance conditions. Furthermore, people outdoors may experience sound from the HVDC transmission lines, but that sound would be attenuated indoors, where people typically sleep. With windows closed, under fair weather HVDC line conditions, operations and maintenance sound levels would be 10–20 dBA lower than those predicted outside, so sleep disturbance is unlikely.

The Applicant would investigate noise complaints obtained via their Communications Plan.

3.11.6.6 Irreversible and Irretrievable Commitment of Resources

With the implementation of EPMs and identified BMP to resolve potential noise impacts to NSAs, no irreversible or irretrievable commitments of resources related to noise are anticipated.

3.11.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Construction noise would temporarily impact nearby NSAs. Noise levels associated with operations and maintenance of the Project would not impact long-term productivity. Changes in sound level associated with the Project would not be expected to negatively impact current land use and activities.

3.11.6.8 Impacts from Connected Actions

3.11.6.8.1 Wind Energy Generation

The impacts from connected actions include those associated with the wind energy generation facilities that would interconnect to the Project as a result of the Project. The anticipated connected actions are all located within Region 1, in the Oklahoma Panhandle and the adjacent portions of Texas. Although site-specific layouts of wind energy generation facilities in the wind energy development zones identified in Region 1 have yet to be designed, noise impacts from these potential wind energy generation facilities have been qualitatively studied. Noise impacts from the connected actions would result from construction and operations and maintenance of the wind energy generation facilities.

3.11.6.8.2 Construction Noise

Construction noise would result from the use of construction equipment to build the wind energy generation facilities. Construction of wind energy generation facilities typically includes the following stages: site clearing, excavation, foundation work, and wind turbine installation. The layouts and design of each wind energy facility are unknown, so the mix of construction equipment needed, the schedule, and duration of construction noise are also unknown. Nevertheless, construction noise would result from motorized construction equipment used for general construction, some of which is included in Tables 3.11-4 and 3.11-5. Because of the temporary nature of construction noise, construction noise impacts from connected actions are not considered significant as they would not permanently impact nearby NSAs.

3.11.6.8.3 Operational Noise

Noise from operation of wind energy generation facilities would result from the operation of wind turbines, and maintenance of the wind energy developments. Because there are no site-specific plans for the wind energy development areas, it is not possible to analyze noise impacts for each potential wind energy generation development area. Site-specific acoustic analyses would be required for each wind energy development to assess potential impacts to the affected NSAs. Nevertheless, for the purposes of this qualitative discussion, operations and maintenance noise levels at referenced distances are provided for wind turbine types with power output capacities ranging from 1.5MW to 3.5MW in Table 3.11-12. Noise levels associated with modern wind turbine generators are mainly a result of aerodynamic noise produced from air flow and the interaction with the wind turbine tower structure and moving rotor blades. Recent improvements in the design of wind turbine mechanical components and the use of improved noise damping materials within the nacelle, including elastomeric elements supporting the generator and gearbox, have minimized mechanical noise emissions (Hau 2006). The sound levels presented in Table 3.11-12 are approximate values only meant to provide the reader a rough representation of potential noise impacts from one wind turbine operating in isolation over an intentionally conservative acoustically hard surface like pavement. If more than one wind turbine generator is operating in relative proximity, the received sound levels at those set distances would be expected to increase. For example, if two GE 1.5sle turbines are located within 1,000 feet of a given NSA, the resulting sound level would be 3 dBA higher than that listed in Table 3.11-12, or approximately 50 dBA L_{eq}.

Table 3.11-12:
Representative Sound Levels for Selected Wind Turbine Generators

Wind Turbine Generator[1]	Rotor Diameter (meter)	Hub Height (meter)	Megawatts	Sound Power Level (dBA L_w)	Received Sound Level (dBA L_{eq})		
					1,000 feet	1,200 feet	1,500 feet
GE 1.5sle	87	77	1.5	106	47	45	43
Siemens 2.3-101	101	80	2.3	108.5	49	48	46
Siemens 3.0-113	113	99.5	3.0	108.5	50	48	46

1 Includes a k-factor or uncertainty factor of +/- 2 dB for the GE 1.5sle and +/- 1.5 dB for the Siemens turbines
Source: GE (2005), Siemens (2008), Bodwell (2013)

As wind development projects are established in the WDZs, each would be required to proceed through state, local, and other permitting efforts as applicable.

3.11.6.8.4 Optima Substation

There are no NSAs located within 0.75 mile from the future Optima Substation, so noise levels from construction, operations and maintenance, and decommissioning of the substation are not anticipated to result in impacts.

3.11.6.8.5 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impacts sections below.

Noise impacts associated with upgrades to existing TVA facilities are not likely to affect NSAs assuming that upgrades would not include addition of transformers or other noise-generating equipment, whereas the required new TVA electric transmission line could cause previously unaffected NSAs to be impacted by noise generated during construction or operations and maintenance. Since the proposed new TVA line is a 500kV AC transmission line, it is expected that construction activities and noise levels would be similar to those described for the Project AC collection system in Section 3.11.6.2.2.1. Construction activities exceeding the FTA guidelines of 90 dBA L_{eq} for daytime activities and 80 dBA L_{eq} for nighttime activities could result in adverse impacts to nearby NSAs. In addition, it is expected that operational noise associated with the TVA line would be similar to noise generated by the Project 500kV AC transmission line as described in Section 3.11.6.2.2.2. Operations and maintenance activities exceeding the EPA guideline of 55 dBA L_{dn} could result in adverse impacts to nearby NSAs.

3.11.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. Accordingly, no impacts related to noise from the Project would occur.

Contents

Tables

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3.12 Recreation

This section provides baseline information regarding outdoor recreation uses on public and private lands that could be affected by the Project. Included within this section is a description of the regulations and standards of federal, state, and local land management agencies that provide recreation opportunities; existing recreational opportunities and activities; and an assessment of potential impacts that might result from the Project.

3.12.1 Regulatory Background

Recreation laws, regulations, and standards relevant to the resources in the ROI are summarized in Table 3.12-1. Applicable permits are discussed in further detail in Appendix C. The regulatory background for the ODWC WMAs, AGFC WMAs, ANHC Natural Areas, USFWS NWRs, USFS lands, and USACE lands are described in Section 3.10.

Table 3.12-1:
Recreation Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Federal		
The National Trails System Act (16 USC § 1241 *et seq.*)	National Park Service (NPS)	The Trail of Tears crosses eight states, including Tennessee, Oklahoma, and Arkansas, and the ROI crosses some portions of the trail in each state. Recreation is available along the trail itself in the form of driving or walking and at developed sites and communities along the trail; however, there are no developed Trail of Tears sites that are crossed by the Project (NPS 2014c). While the ROI would cross the Trail of Tears National Historic Trail, there are no specific permits or authorizations required from the NPS.
1979 Presidential Directive, Memorandum for the Heads of Departments and Agencies regarding Nationwide Rivers Inventory	National Park Service	The Nationwide Rivers Inventory (NRI) rivers are free-flowing river segments that are believed to possess one or more "outstandingly remarkable" natural or cultural values believed to be more than locally or regionally significant (NPS 2011d). A presidential directive requires each federal agency, as part of its normal planning and environmental review processes, to take care to avoid or mitigate adverse effects on rivers identified in the Nationwide Rivers Inventory compiled by NPS. Further, all agencies are required to consult with the National Park Service prior to taking actions which could effectively foreclose wild, scenic or recreational status for rivers on the inventory (NPS 2011a). Guidance issued by CEQ on the NRI recommends that federal agencies should take care to avoid or mitigate adverse effects on rivers identified in the NRI and should consult with the National Park Service to ensure that a federal agency action does not adversely affect the natural, cultural and recreational values of the NRI river segment. Further, this guidance recommends that where a federal agency determines that its action may have adverse effects, the agency should incorporate avoidance/mitigation measures into the proposed action to maximum extent feasible within the agency's authority (NPS 2011d).
National Scenic Byways Program (23 USC § 162) Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA; Public Law 102-240)	The Federal Highway Administration (FHA)	A scenic byway is a public road with special scenic, historic, recreational, cultural, archaeological, and/or natural qualities that have been recognized as such through legislation or official declaration. Easements associated with scenic byway ROWs may prohibit construction of transmission structures or other structures that degrade the scenic quality of the road. Regulations provide that where a project crosses a scenic byway that has been acquired or improved using federal aid or direct federal highway funds, and is located within or adjacent to areas of scenic enhancements and natural beauty, such crossing are prohibited unless granted an exception by the applicable state transportation department pursuant to criteria set forth in 23 CFR 645.209(h)(1).

Table 3.12-1:
Recreation Laws and Regulations Applicable to the Project

Statute/Regulation	Agency	Applicability to the Project
Historic Route 66 Corridor Preservation Program (Public Law 106-45)	National Park Service (NPS)	Historic Route 66 is a national scenic byway administered by the FHWA, but is also part of the Historic Route 66 Corridor Preservation Program (Pub. L. 106-45) administered by the National Park Service (NPS 2014a). The program collaborates with private property owners; non-profit organizations; and local, state, federal, and tribal governments to identify, prioritize, and address Historic Route 66 preservation needs.
State		
Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) (Public Law 102-240) Arkansas Code Annotated (ACA) 27-67-203	Arkansas State Highway Commission	The act created the National Scenic Byways program, but also encouraged states to develop their own scenic byway program. The Arkansas Highway Commission created criteria by which routes could be designated into the state program (AHTD 2007d). Arkansas has two designations for scenic roads within the state: Scenic Highway and Scenic Byways. Arkansas Scenic Highways are designated by the Arkansas General Assembly; however, there are no requirements or prerequisites to designation. Designated Arkansas Scenic Highways are codified and listed in Arkansas Code 27-67-203. Arkansas Scenic Byways are established by the Arkansas Highway Commission under the IS TEA. State Scenic Byway Designation is a prerequisite for nomination and designation as a National Scenic Byway. A roadway must first be designated as an Arkansas Scenic Highway by the Arkansas General Assembly before it can become an Arkansas Scenic Byway under IS TEA.
Local		
City and county zoning ordinances, development regulations, and general or comprehensive plans under Arkansas Code Title 14 Local Government; Oklahoma Statutes Title 19 Counties and County Officers, Section 863.1 City and County Planning and Zoning through Section 863.29 Exclusive Control by Commission; Tennessee Statute Title 6 Cities and Towns, Municipal Government Generally, Chapter 54 Municipal Powers Generally and Chapter 58 Comprehensive Growth Plan	Local governments (cities and counties) in Arkansas, Oklahoma, and Tennessee	These resources are managed by the individual rules and regulations of cities, counties, and towns in which they occur, which may include zoning regulations, comprehensive plans, recreation plans, open space plans, trail plans, and similar land use planning documents.
Oklahoma Scenic Rivers Act (Oklahoma Statues Title 82-1451– 1471)	Oklahoma Water Resources Board (OWRB)	The OWRB is responsible for administration of the state Scenic Rivers Act to preserve the high quality and unique characteristics of outstanding water resources. There are five streams protected under the program in Oklahoma, including Lee Creek and Little Lee Creek. No other rivers designated under the Oklahoma Scenic Rivers Act occur within the ROI.

3.12.2 Data Sources

Recreational resources identified through review of existing datasets for land ownership, and aerial imagery were used to determine the various recreation land uses within the ROI. GIS data sources include ESRI (2013). Ground and aerial reconnaissance by Clean Line and comments received during stakeholder outreach and the DOE scoping process supplemented the desktop information.

Jurisdiction and land ownership in Oklahoma and Arkansas were obtained from the Oklahoma Gap Analysis Project and Arkansas GeoStor (GIS Data Sources: OSU 2003; AHTD 2006a, 2006b, 2006c), respectively. Scenic byways data were obtained from the National Scenic Byways Program and Arkansas GeoStor (GIS Data Sources: FHWA 2013; AHTD 2006a). Scenic byways data were not available for Oklahoma.

NRI data and National Wild and Scenic Rivers data were obtained from the NPS and the USGS (GIS Data Sources: IWSRCC 1999; USGS 1996), respectively. Oklahoma and Arkansas scenic rivers data were obtained from the Oklahoma Scenic Rivers Program (Oklahoma Statutes 82-1451–1471), the ADEQ (*Arkansas Natural and Scenic Rivers System Act* [ACA 15-23-301–315]) and the National Hydrography Dataset (GIS Data Source: USGS 2014a).

3.12.3 Region of Influence

For recreation, the ROI for the Project and connected actions is the same as described in Section 3.1.1.

3.12.4 Affected Environment

The affected environment includes the recreation resources described for the ROI in Regions 1 through 7. A review of the existing recreational opportunities in the ROI provides the context for assessing potential effects to recreational resources and opportunities. Recreational areas include federal, state, and local parks; forests, lakes, rivers, museums, historic sites, and hunting grounds.

Recreation opportunities range from active pursuits such as hiking, water sports, hunting, and fishing, to sedentary recreation like sightseeing, car tours, and picnicking at many of the recreation areas throughout the ROI.

3.12.5 Regional Description

3.12.5.1 Region 1

Region 1 is referred to as the Oklahoma Panhandle Region and includes the Applicant Proposed Route, HVDC Alternative Routes I-A through I-D, and the AC collection system. The ROI for Region 1 HVDC routes does not cross any recreational resources. The ROI for the AC collection system would cross portions of the following recreational areas:

- The Optima NWR
- Optima WMA
- Schultz WMA and State Park

The southern edges of the Optima NWR and WMA would be located within the ROI for AC Collection System Route E-1. The Optima NWR is managed by the USFWS and offers opportunities for public shotgun or archery hunting and wildlife watching. The Optima NWR is part of a larger complex of conservation lands near Hardesty, Oklahoma, that includes the Optima WMA. The Optima WMA includes land adjacent to the Optima NWR along the Beaver River and the Optima Reservoir. The Optima WMA is managed by the ODWC and is open to public hunting (USFWS 2014). The Optima WMA also offers two designated primitive camping areas and a rifle range (ODWC 2014a).

The ROIs associated with AC Collection System Routes E-3, SE-1, SE-3, and E-2 would cross the edges of the Schultz WMA and State Park. The Schultz WMA and State Park, located south of Hardesty, is managed by the ODWC and offers hunting (ODWC 2014b).

There are no Texas-managed recreation areas or state designated recreational rivers in the AC collection system ROI in Texas (TPWD 2014a).

3.12.5.2 Region 2

Region 2 is referred to as the Oklahoma Central Great Plains Region and includes the Applicant Proposed Route and HVDC Alternative Routes 2-A and 2-B. Facilities in Region 2 include the HVDC transmission line; the ROI would cross portions of the Major County WMA.

The Major County WMA would be directly adjacent to the ROI for HVDC Alternative Route 2-A east of Woodward, Oklahoma and north of Chester, Oklahoma in Major County. Major County WMA is located in Major County in northwest Oklahoma. This WMA is managed by the ODWC. Hunting is allowed in this WMA, and fishing opportunities are very limited. There is no camping in the WMA (ODWC 2011).

3.12.5.3 Region 3

Region 3 is referred to as the Oklahoma Cross Timbers Region and includes the Applicant Proposed Route and HVDC Alternative Routes 3-A through 3-E. Facilities in Region 3 include the HVDC transmission line. The ROI would cross portions of the following recreational areas:

- Robert S. Kerr Lake and Webbers Falls Reservoir
- Historic Route 66
- Lake Carl Blackwell

Robert S. Kerr Lake Recreation Area and Webbers Falls Reservoir are interconnected waterways and would be crossed by the ROI associated with the Applicant Proposed Route Link 6 near the Muskogee-Sequoyah county line, west of Gore, Oklahoma. Robert S. Kerr Lake is located on the McClellan-Kerr Arkansas River Navigation System. The lake features fishing, hunting, camping, picnicking, water sports, sightseeing, swimming, and hiking for recreation (USACE 2014a).

Historic Route 66 would be crossed by the ROI associated with Applicant Proposed Route Link 4 north of Bristow, Oklahoma and HVDC Alternative Route 3-C north of Depew, Oklahoma. Historic Route 66 is a national scenic byway administered by the FHWA but is also part of the Historic Route 66 Corridor Preservation Program (PL 106-45) administered by the NPS. The program collaborates with private property owners; non-profit organizations; and local, state, federal, and tribal governments to identify, prioritize, and address Historic Route 66 preservation needs (NPS 2014a; FHWA 2014d).

Lake Carl Blackwell would be crossed by the ROI associated with HVDC Alternative Routes 3-A and 3-B and Proposed Route Link 1, west of Stillwater, Oklahoma. Lake Carl Blackwell, managed by the Oklahoma State

University, is located west of Stillwater and provides camping and cabins, horseback riding trails, fishing, water sports, hunting, and hiking (OSU 2014).

3.12.5.4 Region 4

Region 4 is referred to as the Arkansas River Valley Region and includes the Applicant Proposed Route and HVDC Alternative Routes 4-A through 4-E as well as the Lee Creek Variation. Facilities in Region 4 include the HVDC transmission line. The ROI would cross portions of several recreational areas including:

- Robert S. Kerr Lake and Webbers Falls Reservoir
- Ozark National Forest
- Ozark National Forest WMA
- Frog Bayou WMA
- Ozark Lake WMA
- Scenic Byways
- Portions of the Lee and Little Lee Creeks rivers managed by the Oklahoma Water Resources Board (OWRB) and listed on the NRI
- Arkansas Scenic Byways: State Highway 540/Boston Mountains Scenic Loop; State Highway 23/Pig Trail Byway; and State Highway 21/Ozark Highlands Scenic Byway
- Arkansas Scenic Highways: State Highway 220, State Highway 59, Interstate Highway 40, U.S. Highway 71
- The Trail of Tears National Historic Trail

Robert S. Kerr Lake and Webbers Falls Reservoir would be crossed by the ROI associated with the Applicant Proposed Route Link 1 of Region 4 west of Salisaw, Oklahoma. Robert S Kerr Lake and Webbers Falls Reservoir is located on the Oklahoma portion of the McClellan-Kerr Arkansas River Navigation System. Webbers Falls Reservoir features fishing, hunting, camping, picnicking, water sports, and sightseeing for recreation (USACE 2014b). Robert S. Kerr Lake features fishing, hunting, camping, picnicking, water sports, sightseeing, swimming, and hiking for recreation (USACE 2014a).

Ozark National Forest would be crossed by the ROI associated with HVDC Alternative Route 4-B. The crossing would take place along the southern end of the National Forest north of Fort Smith Arkansas. Many opportunities for recreation exist in the Ozark National Forest including biking, camping, climbing, fishing, hiking, horseback riding, hunting, nature and wildlife viewing, water sports (both motorized and non-motorized), and scenic driving (USFS 2014). No specific recreation areas, such as boat launches, campgrounds, or shooting ranges, are located within the ROI or crossed by the Applicant Proposed Route and HVDC Alternative Routes (USFS 2014). Within the Ozark National Forest there are public and private land holdings. The recreation opportunities are available only in the publicly held tracts of land. Impacts to private inholdings within the Ozark National Forest are addressed in Section 3.10.

The Ozark National Forest WMA, where it is crossed by the HVDC Alternative Route 4-B, shares the same boundaries as the Ozark National Forest (located in the Boston Mountain Ranger District). The Ozark National Forest WMA is located within the National Forest of the same name and is located in parts of Conway, Crawford, Franklin, Johnson, Madison, Newton, Pope, Searcy, Van Buren, and Washington counties in Oklahoma. Hunting is allowed in the WMA with the exception of alligator and elk hunting. All other species are allowed (AGFC 2011d). The Ozark

National Forest WMA represents a zone where the AGFC manages the wildlife, but the USFS is the landowner. Each WMA is a separate zone for which the AGFC may establish and apply hunting regulations (AGFC 2014).

Frog Bayou WMA would be crossed by the ROI associated with the Applicant Proposed Route Link 6, west of Mulberry and south of Dyer, Arkansas. Frog Bayou WMA is managed by the AGFC and is located east of Van Buren along the Arkansas River. This WMA features hunting, with the exception of alligator and elk, and wildlife viewing, and it abuts USACE-managed land along the Arkansas River (AGFC 2011b).

Ozark Lake would be crossed by the ROI associated with the Applicant Proposed Route Link 6, west of Mulberry and east of Dyer, Arkansas. Ozark Lake WMA is managed by the AGFC and is located east of Van Buren along the Arkansas River on land managed by the USACE. The WMA features hunting with the exception of bear, alligator, and elk (AGFC 2011c).

Some segments of the Big Piney Creek are considered part of the NRI for Arkansas. The segments of the Big Piney Creek that are listed on the NRI are located from the upper Dardanelle Reservoir, to the headwaters near Fallsville, Arkansas. The Big Piney Creek segments on the NRI have the outstanding remarkable values of scenery, recreation, geology, fish, and wildlife (NPS 2004).

Lee Creek and Little Lee Creek NRI segments would be crossed by the ROI associated with HVDC Alternative Routes 4-A and 4-B and Applicant Proposed Route Link 3 north of Fort Smith, Arkansas. Lee Creek NRI segments would be crossed by the ROI associated with the Lee Creek Variation. Lee and Little Lee Creeks OWRB state natural and scenic river segments would be crossed by the ROI associated with HVDC Alternative Routes 4-A and 4-B north of Fort Smith in Sequoyah County, Oklahoma. Lee Creek is not considered a federally designated Wild and Scenic River, although it is included on the NRI for Oklahoma and Arkansas. The Lee Creek segments included on the NRI encompass 49 miles of river in Sequoyah County, Oklahoma, to the headwaters near Moffet, Arkansas, and have the outstanding remarkable values of scenery, recreation, fish, wildlife, and cultural (NPS 2011b, 2010). The OWRB manages the Lee and Little Lee Creeks state natural and scenic river segments in Sequoyah County, Oklahoma, and have the outstanding remarkable values of scenery, recreation, fish, wildlife, and cultural (NPS 2010). Review of available data shows that the Lee Creek and Little Lee Creek segments are part of the NRI and the OWRB Natural and Scenic Rivers System.

Oklahoma Highway 100, or the Cherokee Hills National Scenic Byway, would be crossed by the ROI associated with the Applicant Proposed Route Link 1 west of Sallisaw, Oklahoma. The Cherokee Hills National Scenic Byway is located on the western foothills of the Ozark Mountains and has scenic, cultural, and historic values (FHWA 2014a). Arkansas Highway 21, also known as the Ozark Highlands Scenic Byway, is crossed by Proposed Route Link 9 and Alternative Route 4-E north of Clarksville, Arkansas. The Ozark Highlands Scenic Byway is designated under the Arkansas State Scenic Byways program and is a scenic drive with recreational opportunities through the Boston Mountains region of the Ozark Mountains (AHTD 2007b).

The Boston Mountains Scenic Loop (Interstate 540 and US Highway 71) would be crossed by the ROI associated with HVDC Alternative Routes 4-A, 4-B, and 4-D north of Van Buren, Arkansas. This scenic loop, designated under the Arkansas State Scenic Byways program, has several high-span bridges and scenic and historic views (AHTD 2007a).

Pig Trail Scenic Byway would be crossed by the Applicant Proposed Route and HVDC Alternative Route 4B. The Pig Trail Scenic Byway is designated for 19 miles between the southern boundary of the Ozark National Forest to the intersection with Arkansas Highway 16 (Arkansas.com 2014).

State Scenic Highway 220 would be crossed by HVDC Alternative Routes 4-A and 4-B. State Scenic Highway 59 would be crossed by HVDC Alternative Routes 4-C, 4-D and the Applicant Proposed Route. Interstate 40 would be crossed twice by both HVDC Alterative Route 4-A and the Applicant Proposed Route. U.S. Highway 71 would be crossed by HVDC Alternative Route 4-D.

The Trail of Tears is located across eight states including Tennessee, Oklahoma, and Arkansas. Recreation is available along the trail itself in the form of driving or walking (NPS 2014c). There are no interpretive centers or sites along the Trail of Tears; the only park facility is the trail itself, which can be used for hiking (NPS 2014b). The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. The historic significance of the Trail of Tears is addressed in detail in Section 3.9.

3.12.5.5 Region 5

Region 5 is referred to as the Central Arkansas Region and includes the Applicant Proposed Route and HVDC Alternative Routes 5-A through 5-F. Facilities located in Region 5 include the HVDC transmission line and the Arkansas converter station alternative. Portions of the Cherokee WMA, Rainey WMA, segments of Cadron Creek listed on the NRI, and scenic byways would be crossed by Project features. Region 5 also crosses Arkansas Scenic 7 Byway, and Arkansas State Scenic Highways: State Highway 27, State Highway 9, U.S. Highway 65, State Highway 25, State Highway 5, and State Highway 16.

The Cherokee WMA would be within part of the Arkansas Converter Station Alternative Siting Area and Alternative AC Interconnection Siting Area. The Cherokee WMA is also located in the ROI associated with the Applicant Proposed Routes Links 2 and 5. Portions of the Cherokee WMA are located in eight different counties in Arkansas. The portion located within the Arkansas Converter Station Alternative Siting Area and the ROI for the Applicant Proposed Route is located in Pope County, is leased by the state from private ownership, and is referred to as Cherokee Area 8 (AGFC 2011a). Permitted game hunting on the overall WMA includes turkey, deer, bear, quail, rabbit, squirrel, and crow.

Rainey WMA would be located within the northern portion of the Arkansas Converter Station Alternative Siting Area and in the northeastern portion of the Arkansas Converter Station Alternative AC routes siting area. Rainey WMA is located in Pope County Arkansas and allows hunting of game species with the exception of elk and alligator (AGFC 2011e).

Cadron Creek segments listed on the NRI would be crossed by the ROI associated with HVDC Alternative Routes 5B, 5E, and 5F west of Guy, Arkansas. Cadron Creek is in the ROI associated with the Applicant Proposed Route Link 3 east of Damascus, Arkansas. Cadron Creek is crossed by the ROI associated with the Applicant Proposed Route Link 4 southeast of Quitman, Arkansas. Cadron Creek is not considered a federally designated Wild and Scenic River, although it is included on the NRI for Arkansas. The segments of Cadron Creek included on the NRI are located from the confluence of Cadron Creek with the Arkansas River near Gleason, Arkansas, to the headwaters, east of Pearson, Arkansas. The east fork of Cadron Creek also has segments included on the NRI that are located from the confluence of the East Fork and Cadron Creek north of Gleason, Arkansas, to the headwaters east of Rose Bud, Arkansas. The Cadron Creek and East Fork segments on the NRI have the outstanding remarkable values of scenery, recreation, geology, fish, and wildlife (NPS 2004).

The East Fork of Cadron Creek would be crossed by the ROI associated with HVDC Alternative Routes 5B, 5E, and 5F in Faulkner and White counties, Arkansas and is designated as part of the NRI system from the confluence of the East Fort and Cadron Creek north of Gleason upstream to the headwaters east of Rose Bud, Arkansas. The East Fork of Cadron Creek segments on the NRI have the following Outstanding and Remarkable Values (ORVs): scenic, recreational, geologic, fish and wildlife (NPS 2004).

Arkansas Scenic 7 Byway would be crossed by the ROI associated with the Applicant Proposed Route Link 1 and HVDC Alternative Route 5-A. The Arkansas Scenic 7 Byway travels almost 300 miles and provides views of several different regions of the state. The route is known for scenic views and proximity to recreation (AHTD 2007c).

Arkansas State Scenic Highway 27 would be crossed by HVDC Alternative Route 5-A, and the Applicant Proposed Route. Arkansas State Scenic Highway 9 would be crossed by HVDC Alternative Route 5-B and the Applicant Proposed Route. U.S. Highway 65 would be crossed by HVDC Alternative Route 5-B and the Applicant Proposed Route. Arkansas State Scenic Highway 25 would be crossed by HVDC Alternative Route 5-E and the Applicant Proposed Route. Arkansas State Scenic Highway 5 would be crossed by HVDC Alternative Route 5-B and the Applicant Proposed Route. Arkansas State Scenic Highway 16 would be crossed by HVDC Alternative Route 5-B, 5-C and the Applicant Proposed Route.

3.12.5.6 Region 6

Region 6 is referred to as the Cache River and Crowley's Ridge Region and includes the Applicant Proposed Route and HVDC Alternative Routes 6-A through 6-D. Facilities located in Region 6 include the HVDC transmission line. The ROI would cross portions of the following recreational areas: USFWS acquisition areas, the Singer Forest Natural Area/St. Francis Sunken Lands WMA, portions of the L'Anguille River on the NRI, and scenic byways/highway.

Portions of USFWS acquisition areas, associated with the Cache River NWR, would be crossed by the ROI associated with HVDC Alternative Route 6-B near Amagon, Arkansas, and by the ROIs associated with the Applicant Proposed Route Links 3 and 4, and HVDC Alternative Route 6-A north and west of Fisher, Arkansas. An acquisition area is an area that has been identified for purchase by the agency, should the opportunity arise. These areas are typically identified surrounding federally owned land in an attempt to expand the boundaries of the federal land holding. Acquisition areas are not owned, nor are they managed by the USFWS, although they have been identified for future purchase. No proposed or alternative routes or ROIs cross portions the Cache River NWR.

The Singer Forest Natural Area/St. Francis Sunken Lands WMA would be crossed by the ROI associated with the Applicant Proposed Route Link 7. The portion of the Singer Forest Natural Area/St. Francis Sunken Lands WMA that occurs within the Applicant Proposed Route is located in Pointsett County, Arkansas. This section of the lands encompasses a total of 520 acres in the Mississippi Alluvial Plain. The Natural Area consists of forested wetlands, bottomland forest, and overflow swamp. Hunting is allowed for turkey, deer, quail, rabbit, squirrel, and crow, and disallowed for alligator, elk, bear, and deer hunted with a muzzleloader (ANHC 2014b).

Portions of the L'Anguille River included in the NRI system would be crossed by the ROI associated with HVDC Alternative Route 6-C, and Applicant Proposed Route Link 6 west of Marked Tree, Arkansas. The L'Anguille River is not considered a federally designated Wild and Scenic River, although it is included on the NRI for Arkansas. The segments of L'Anguille River included on the NRI are located from the confluence of the L'Anguille River with the St. Francis Floodway near Marianna, Arkansas, to the Poinsett-Cross county line. The segments of the L'Anguille River included on the NRI have the outstanding remarkable values of scenic, recreation, fish, and wildlife (NPS 2004).

Crowley's Ridge Parkway National Scenic Byway would be crossed by the ROI associated with the Applicant Proposed Route Link 6 and HVDC Alternative Route 6-C south of Harrisburg, Arkansas. Recreational opportunities include wildlife and vegetation viewing, natural and historic sites, and Civil War battlefields along Crowley's Ridge Parkway National Scenic Byway (FHWA 2014b). Arkansas State Scenic Highway 14 would be crossed by HVDC Alternative 6-C.

3.12.5.7 Region 7

Region 7 is referred to as the Arkansas Mississippi River Delta and Tennessee Region and includes the Applicant Proposed Route and HVDC Alternative Routes 7-A through 7-D. Facilities located in the ROIs for Region 7 include portions of the Trail of Tears National Historic Trail and the Great River Road National Scenic Byway and Arkansas State Scenic Highway 63. The ROIs associated with the HVDC transmission line also cross the Mississippi River in Region 7.

The Trail of Tears would be crossed by the ROI associated with the Applicant Proposed Route Link 1 and HVDC Alternative Route 7-A across the Mississippi River. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail, and the extent of the trail at each crossing location is not known.

The Great River Road National Scenic Byway would be crossed by the ROI associated with HVDC Alternative Route 7-A west of the Mississippi River crossing (west of Millington, Tennessee, in Arkansas). It is also crossed by the Applicant Proposed Route north of Birdsong, Arkansas, and the Mississippi River Crossing (west of Millington Tennessee in Arkansas). The Great River Road has many historic and cultural resources and scenic views into the River Valley (FHWA 2014c). The Arkansas State Scenic Highway 63 would be crossed by HVDC Alternative Route 7-A and the Applicant Proposed Route.

The Coon Valley Road Boat Launch area on the eastern bank of the Mississippi River in Tennessee would be crossed by the ROI associated with HVDC Alternative Route 7A. The Coon Valley Road Boat Launch appears to be a primitive ramp and parking lot for use by recreational watercraft. It is not clear whether this boat launch is maintained. The Mississippi River in this area is popular for recreational water sports, sightseeing, and fishing from the river even though the banks are steep and wooded and do not provide much access to the waterfront.

3.12.5.8 Connected Actions

3.12.5.8.1 Wind Energy Generation

There are several municipal parks within WDZ-A, including Leatherman Park, Stark Park, Murphy Park, Whippo Park, and Whighem Park that would be located in Perryton, Texas, in WDZ-A. The parks are located in the city limits of Perryton and have improved ball fields and running trails.

Palo Duro Reservoir is located in WDZ-B, 10 miles north of Spearman, Texas. The lake is a man-made reservoir used mainly for fishing and bird-watching. Palo Duro Reservoir is stocked with many fish species for recreational fishing (TPWD 2014b). Millers Lake and County Road 18 hunting areas in Hansford County, Texas, are used for hunting upland game birds. Hunting areas near Millers Lake are part of the Hansford County complex in the panhandle region of the Texas Parks and Wildlife public hunting lands. The Miller's Lake unit allows for teal, pheasant, sandhill crane, high plains mallard, and western zone goose hunting. The County Road 18 unit allows only pheasant hunting (TPWD 2012).

The Schultz WMA and Optima WMA would be located in WDZ-D. The Schultz WMA is located approximately 4.7 miles south of Hardesty, Oklahoma; 260 acres of the Schultz WMA would be located within the WDZ-D analysis area. The Schultz WMA is managed by the ODWC and offers hunting (ODWC 2014b). Parts of the Optima WMA are located in WDZ-D, 13.9 miles east of Guymon, Oklahoma. There are 256 acres of the Optima WMA located within WDZ-D. The Optima WMA is part of a larger complex of conservation lands near Hardesty, Oklahoma. The Optima WMA includes land adjacent to the Optima NWR along the Beaver River and the Optima Reservoir. The Optima WMA is managed by the ODWC and is open to public hunting (ODWC 2014a).

There are several municipal parks, including the City Park, Jaycee Park, and Womble Park in Spearman, Texas, that would be located in WDZ-L. The parks are located within the city limits of Spearman and have improved ball fields and a swimming pool.

Hunting may also take place in undesignated deciduous forest, evergreen forest, mixed forest, shrub/scrub, grassland/herbaceous, woody wetland, and emergent herbaceous wetland land cover types on both public and private land in all of the WDZs.

There are no recreational resources in WDZ-C, WDZ-E, WDZ-F, WDZ-G, WDZ-H, WDZ- I, WDZ-J, and WDZ-K.

3.12.5.8.2 Optima Substation

There are no recreation resources located within the future Optima Substation Siting Area.

3.12.5.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.12.6 Impacts to Recreation

Comments related to recreation received during the scoping period indicate that the public is concerned about impacts to public lands designated for recreation, including national forests and parks, state forests and parks, Scenic Byways and Highways, and Extraordinary Resource Waters specifically regarding fishing, hunting, hiking, camping, and canoeing opportunities within all regions of the Project. The public also expressed concern about impacts to recreation on private lands and requested that the EIS examine the use of the transmission line easement areas for recreational activities.

3.12.6.1 Methodology

To identify potential impacts that may result from construction and operations and maintenance of the Project, the Applicant Proposed Route, HVDC t route alternatives, the Oklahoma and Arkansas AC interconnection areas, and the AC collection system were analyzed based on a desktop review of existing recreational uses within a representative 200-foot corridor—100 feet on either side of a representative centerline. Quantitative data regarding the resources directly intersected by the 200-foot-wide corridor, the representative ROW for the purposes of this analysis, were used to analyze the likely effects of the Project on recreation. For the converter stations, it was assumed that 45 to 60 acres would be required within the Oklahoma and Tennessee Converter Station Siting Areas, and 40 to 50 acres would be affected within the Arkansas converter station, although the exact locations have not yet been determined. Because the exact location of access roads, 45 multi-use construction yards (approximately 25 acres each), and other anticipated temporary construction areas and access roads have not yet been determined, these impacts were evaluated in a general qualitative way.

Although exact access road locations have not yet been determined, it has been assumed each converter station would have an access road 20 feet wide by up to 1 mile long (2 acres), with temporary disturbance up to 35 feet wide (4 acres total, 2 acres temporary and 2 permanent).

The Applicant has developed a comprehensive list of EPMs that would avoid and minimize impacts to recreation resources. Implementation of these EPMs is assumed throughout the impact analysis that follows for both the Applicant Proposed Project and the DOE Alternatives. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically avoid or minimize impacts on recreation resources are listed below:

- GE-1: Clean Line will train personnel on health, safety, and environmental matters. Training will include practices, techniques, and protocols required by federal and state regulations and applicable permits.
- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-7: Roads not otherwise needed for maintenance and operations will be restored to preconstruction conditions. Restoration practices may include decompacting, recontouring, and re-seeding. Roads needed for maintenance and operations will be retained.
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-26: When needed, Clean Line will use guard structures, barriers, flaggers, and other traffic controls to minimize traffic delays and road closures.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures

- LU-5: Clean Line will make reasonable efforts, consistent with design criteria, to accommodate requests from individual landowners to adjust the siting of the ROW on their properties. These adjustments may include consideration of routes along or parallel to existing divisions of land (e.g., agricultural fields and parcel boundaries) and existing compatible linear infrastructure (e.g., roads, transmission lines, and pipelines), with the intent of reducing the impact of the ROW on private properties.
- FVW-1: Clean Line will identify environmentally sensitive vegetation (e.g., wetlands, protected plant species, riparian areas, large contiguous tracts of native prairie) and avoid and/or minimize impacts to these areas.
- FVW-3: Clean Line will clearly demarcate boundaries of environmentally sensitive areas during construction to increase visibility to construction crews.
- W-2: Clean Line will identify, avoid, and/or minimize adverse effects to wetlands and waterbodies. Clean Line will not place structure foundations within the Ordinary High Water Mark of Waters of the United States.
- W-6: The Applicant will not construct counterpoise or fiber optic cable trenches across waterbodies.

3.12.6.2 Impacts Associated with the Applicant Proposed Project

This section describes the potential impacts from the Project that would be common to the converter stations, AC interconnection siting areas, AC collection system, and Applicant Proposed Route that are a part of the Applicant Proposed Project. Impacts from the construction, operations and maintenance, and decommissioning of the Project are discussed separately by Project component.

3.12.6.2.1 Converter Stations and AC Interconnection Siting Areas

3.12.6.2.1.1 Construction Impacts

Impacts to recreation resources are not expected from construction within the Oklahoma Converter Station or AC Interconnection Siting Area because there are no recreation resources in these areas. Construction of the Tennessee Converter Station and AC Interconnection Siting Area would not impact any recreation resources because no recreational resources in these areas.

3.12.6.2.1.2 Operations and Maintenance Impacts

No impacts to recreation resources are expected from operations and maintenance of the Oklahoma or Tennessee Converter Station or associated AC interconnections because no recreation resources are located within these areas.

3.12.6.2.1.3 Decommissioning Impacts

No impacts to recreation resources are expected from decommissioning of the converter stations or AC interconnections because no recreation resources are located within these areas.

3.12.6.2.2 AC Collection System

This section discusses the data reviewed within the 200-foot-wide representative ROWs of the AC collection system.

3.12.6.2.2.1 Construction Impacts

Construction of the AC collection system is not expected to permanently preclude the use of or access to any existing recreation areas or activities since no recreation resources have been identified within the representative ROW for any AC collection system routes. No impacts to recreation resources are anticipated from construction of AC

Collection System Routes E-1, E-2, E-3, NE-1, NE-2, NW-1, NW-2, SE-1, SE-2, SE-3, SW-1, SW-2, and W-1 because no recreation resources are located within the representative ROW.

Two of the AC Collection System Routes are located in close proximity to recreation resources. The southern boundaries of the Optima NWR and the Optima WMA are located to the north of AC Collection System Route E-1. At the closest point, the Optima NWR and the Optima WMA are approximately 1,500 feet from this route, and about 1.5 miles from the Optima lake shoreline, which is within the NWR and WMA areas.

The boundaries of the Schultz Lake State Park and Schultz WMA are located to the north of AC Collection System Route SE-1. At the closest point, the Schultz Lake State Park and Schultz WMA are approximately 0.5 mile from the alternative. Long-term indirect impacts would result from vegetation clearing and structure erection and could have impacts on recreational visitor due to changes in the scenic landscapes provided by the Optima NWR and Optima WMR.

3.12.6.2.2.2 Operations and Maintenance Impacts

No impacts to recreation resources are anticipated from operations and maintenance of any of the AC collection system routes because no recreation resources are located within the representative ROW.

3.12.6.2.2.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning has been completed, all land would return to the preconstruction recreational land uses.

3.12.6.2.3 HVDC Applicant Proposed Route

This section identifies the potential impacts from the Applicant Proposed Route on recreation based on the three phases of the Project: construction, operations and maintenance, and decommissioning. The Applicant would conduct each phase in compliance with applicable state and federal laws, regulations, and permits related to environmental protection. Specific EPMs developed to avoid and minimize impacts are described in Section 3.12.6.6.1.

3.12.6.2.3.1 Construction Impacts

This section describes the potential impacts to recreation during the construction phase of the Project within the 200-foot-wide representative ROWs of the Applicant Proposed Route.

Construction of the Project is not expected to permanently preclude the use of or access to any existing recreation areas or activities; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access may diminish the quality of a recreational visit. The Applicant expects the duration of construction in each 140-mile segment to be approximately 24 months from mobilization of equipment to site restoration; however, construction at a discrete site would be shorter in duration. The duration of disturbance at any one location along a segment would be less, with the length of disturbance affected by the land use and progress of the individual work crews. Recreational areas are typically more popular on the weekends and during the summer, and since construction activities would be scheduled Monday through Saturday, recreationists would generally be most affected on Saturdays and during the summer months when the recreational lands in the Project regions commonly experience the most use. In most regions of the Project, alternate recreation areas can be found, including private or public land with similar habitat conditions, and hunting seasons vary depending upon each state department of wildlife.

Hunting and wildlife viewing opportunities could be temporarily impacted by the Project if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. Alternately, some wildlife may be temporarily attracted to cleared areas due to an increased availability of food. In such areas, food resources, such as nuts and seeds, left on the ground can be easily found by wildlife. Such displacement could improve hunting and wildlife viewing opportunities in some areas for a short period of time following clearing activities. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Vegetation outside of the ROW may provide visual and noise screening to the affected areas within the ROW.

Direct long-term impacts would result from vegetation clearing and structure erection. The transmission structures could have impacts on scenic landscapes by reducing the quality of the natural or rural landscapes. The extent of these impacts would, however, depend on existing visual conditions in the affected areas, with impacts lower in those areas where high-voltage transmission lines and other types of development are already present. Impacts would also vary based on the distance of the recreation area from the proposed transmission line. Potential effects would tend to be greater in locations where the Project would be visible on the horizon. Site-specific visual impacts are evaluated in detail in Section 3.18.

The sections below describe the recreation resources that would be affected within each region of the Applicant Proposed Route.

3.12.6.2.3.1.1 Region 1 and Region 2

No direct or indirect impacts to recreation resources are anticipated from construction of the Applicant Proposed Route in Region 1 and Region 2 because no recreation resources are located within the representative ROW.

3.12.6.2.3.1.2 Region 3

The Applicant Proposed Route could potentially impact 4 acres of the Webbers Falls Lock and Dam Reservoir lands in Link 6 if the Project is routed on the representative centerline. The tensioning areas associated with the Applicant Proposed Route could potentially impact 1 acre of Webbers Falls Lock and Dam Reservoir lands and would have similar construction impacts. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. The Applicant Proposed Route Link 4 would cross Historic Route 66 near Bristow, Oklahoma. Tensioning areas associated with Applicant Proposed Route Links 3 and 4 would be located adjacent to the Historic Route 66 crossings and construction equipment may be located next to the roadway during construction. Short term impacts during construction may include visual disturbance which could diminish the quality of driving the historic route. It is not anticipated that traffic flow would be restricted during construction.

The Webbers Falls Lock and Dam Reservoir is crossed by the Applicant Proposed Route in Region 3 and is also crossed by several existing transmission lines:

- Gore to Weleetka 161kV

- Gore to Webbers Falls 115kV
- Eufaula to Gore 138kV
- Muskogee to Pittsburg 345kV

3.12.6.2.3.1.3 Region 4

The Applicant Proposed Route could potentially impact 2 acres of the Ozark Lake WMA, 4 acres of the Frog Bayou WMA, 2 acres of the Ozark National Forest, two Arkansas State Scenic Byways, and two Arkansas State Scenic Highways. The Applicant Proposed Route in Region 4, Link 1, could potentially impact 17 acres of the Webbers Falls Lock and Dam Reservoir lands. There is no HVDC Alternative Route to this link of the Applicant Proposed Route. The tensioning areas associated with the Applicant Proposed Route could potentially impact less than 0.1 acre of Webbers Falls Lock and Dam Reservoir lands and 4 acres of the Frog Bayou WMA.

The Mulberry River and Big Piney Creek are designated as an Arkansas Natural and Scenic Rivers where they are crossed by Applicant Proposed Route Link 6. Applicant Proposed Route Link 3 (the Lee Creek Variation) would cross a section of Lee Creek that is designated on the NRI. Applicant Proposed Route Link 9 would cross a section of the Piney Creek that is designated on the NRI. The rivers would likely be spanned.

Applicant Proposed Route Links 1, 5, 6, and 8 would cross the Trail of Tears National Historic Trail. Tensioning areas associated with the Applicant Proposed Route Links 6 and 8 would be located adjacent to the Trail of Tears crossing and construction equipment may be located near the trail during construction. Applicant Proposed Route Link 1 would cross the Cherokee Hills Scenic Byway. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. These impacts would be direct and temporary impacts as defined in Section 3.12.6.2.

The Applicant Proposed Route would cross Arkansas State Scenic Highway 59, Arkansas State Scenic Highway Interstate 40, Arkansas State Scenic Byway 23/Pig Trail Scenic Byway, and Arkansas State Scenic Byway 21/Ozark Highlands Scenic Byway.

Construction of the Applicant Proposed Route is not expected to permanently preclude the use of or access to any existing recreation areas or activities; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Vegetation outside of the ROW may provide visual and noise screening to the affected areas within the ROW.

Long-term direct impacts to Ozark Lake WMA, Frog Bayou WMA, the Mulberry River, and the Big Piney Creek would result from vegetation clearing and structure erection. The Webbers Falls Lock and Dam Reservoir is crossed by the Applicant Proposed Route in Region 3 and is also crossed by several existing transmission lines:

- Gore to Weleetka 161kV
- Gore to Webbers Falls 115kV
- Eufaula to Gore 138kV
- Muskogee to Pittsburg 345kV

3.12.6.2.3.1.4 Region 5

The Applicant Proposed Route could potentially impact 77 acres of the Cherokee WMA and cross several Arkansas Scenic Highways and Byways. The tensioning areas associated with the Applicant Proposed Route could potentially impact 6 acres of the Cherokee WMA. The boundary of the Rainey WMA would be approximately 0.25 miles northeast of the Applicant Proposed Route. Applicant Proposed Route Link 1 would cross the Arkansas Scenic 7 Byway and would span the road. Applicant Proposed Route Link 4 would cross a section of the Cadron Creek listed on the NRI. The rivers would likely be spanned and structures would not be placed within the riparian zones. The Applicant proposed Route would cross the following Arkansas Scenic Highways:

- State Scenic Highway 27
- State Scenic Highway 9
- State Scenic Highway 65
- State Scenic Highway 25
- State Scenic Highway 5
- State Scenic Highway 16

The Cherokee WMA in Region 5 is used for hunting. Hunting opportunities could be temporarily disturbed by the Applicant Proposed Route if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing.

3.12.6.2.3.1.5 Region 6

The Applicant Proposed Route could potentially impact approximately 1 acre of the Singer Forest Natural Area/St. Francis Sunken Lands. The Applicant Proposed Route Link 6 would cross Crowley's Ridge Parkway National Scenic Byway. The Applicant Proposed Route Link 6 would also cross a section of the L'Anguille River listed on the NRI; the transmission line would likely span the river. No tensioning areas that are associated with the Applicant Proposed Route would affect any recreation resources.

The Singer Forest Natural Area/St. Francis Sunken Lands WMA is used for hunting. Hunting opportunities could be temporarily disturbed by the Applicant Proposed Route if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing.

3.12.6.2.3.1.6 Region 7

The Applicant Proposed Route would cross the Great River Road National Scenic Byway at two points, the Trail of Tears National Historic Trail, and Arkansas Scenic Highway 63. The Project is expected to span both the byway and the trail. No tensioning areas that are associated with the Applicant Proposed Route would affect any recreation resources.

Recreation opportunities could be temporarily impacted by the Applicant Proposed Route if construction was visible from the Great River Road and the Trail of Tears. The recreational experience for the Great River Road and Trail of Tears is based in part on the scenic views from these resources and may be impacted by visible construction activities and vegetation clearing. Visual resources are discussed in more detail in section 3.18. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing. Long-term direct impacts to the Great River Road and the Trail of Tears would result from vegetation clearing and structure erection and may diminish the recreational experience if visible from the road or trail.

3.12.6.2.3.2 Operations and Maintenance Impacts

Operation and maintenance activities for facilities would be similar to activities during construction but generally smaller in scale, more localized, and shorter in duration.

The Applicant Proposed Route is not expected to permanently preclude the use of or access to any existing recreation areas or activities; however, some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit.

3.12.6.2.3.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components, except they would last a shorter duration of time. Once the decommissioning is complete, all land would return to the preconstruction recreational land uses.

3.12.6.3 Impacts Associated with the DOE Alternatives

The impacts discussed in the sections below are common to all aspects of the DOE Alternatives, which include the Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area, the HVDC Alternative Routes, access roads, multi-use construction yards and other temporary construction areas, and communications sites.

3.12.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.12.6.3.1.1 Construction Impacts

Impacts from the converter station construction would be similar to those for the Applicant Proposed Route construction as described in Section 3.12.6.2.1. Construction of the Arkansas converter station could temporarily disturb 45 to 60 acres of the Cherokee WMA or Rainey WMA if the converter station is sited in the WMAs which occur within the Arkansas Converter Station Alternative Siting Area. Final locations for the converter station have not been determined. It is assumed that the Cherokee and Rainey WMAs would be avoided and the Arkansas AC interconnection is not anticipated to impact recreation resources.

3.12.6.3.1.2 Operations and Maintenance Impacts

Impacts from the converter station operations and maintenance would be similar to those for the Applicant Proposed Route construction as described in Section 3.12.6.2.1. Impacts from the converter station operations and maintenance would only impact recreational areas if the final location for the converter station is within or adjacent to the Cherokee WMA or the Rainey WMA.

The operations and maintenance of the converter station is not expected to permanently preclude the use of or access to any existing recreation areas or activities, although some direct short-term impacts to these resources, such as noise, visual disturbance, or restricted access, would likely diminish the quality of a recreational visit. Maintenance is expected to occur on an annual basis or as needed and is not expected to permanently preclude the use of or access to any existing recreation areas or activities.

3.12.6.3.1.3 Decommissioning Impacts

Potential impacts during decommissioning of the Project would be similar to those of the construction phase for all Project components. Once the decommissioning has been completed, all land would return to the preconstruction recreational land uses.

3.12.6.3.2 HVDC Alternative Routes

This section discusses the potential impacts within the 200-foot-wide representative ROWs of the HVDC alternative routes during the construction, operations and maintenance, and decommissioning phases of the Project.

3.12.6.3.2.1 Construction Impacts

Construction impacts from the HVDC Alternative Routes would be the same as impacts from the HVDC Applicant Proposed Route and are described in section 3.12.6.2.3. The sections below describe the recreation resources that would be affected within each HVDC alternative route.

3.12.6.3.2.1.1 Region 1 and Region 2

No impacts to recreation lands or uses are anticipated from construction of HVDC alternative routes in Region 1 and Region 2 because no recreation resources are located within the representative ROW. Likewise, no impacts to recreational land or uses are anticipated from construction of corresponding Applicant Proposed Route links in Region 1 and Region 2 because no recreation resources are located within representative ROWs.

3.12.6.3.2.1.2 Region 3

3.12.6.3.2.1.2.1 Alternative Route 3-A

HVDC Alternative Route 3-A could potentially impact 22 acres of the OSU-owned and -managed Lake Carl Blackwell if the Project is routed on the representative centerline. The tensioning areas associated with the HVDC Alternative Route 3-A could potentially impact 0.2 acre of Lake Carl Blackwell. HVDC Alternative Route 3-A and tensioning areas associated with HVDC Alternative Route 3-A crosses Historic Route 66 southwest of Bristow, Oklahoma. Corresponding Applicant Proposed Route Link 1 would not have impacts to recreation resources because no recreation resources are located in the representative ROW.

As described for the Applicant Proposed Route in Region 3, hunting opportunities could be temporarily impacted by construction of HVDC Alternative Route 3-A if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances as described in Section 3.12.6.2.3.1. Views from Route 66 may also be affected from construction of the Project; however, Route 66 would likely be spanned.

3.12.6.3.2.1.2.2 Alternative Route 3-B

HVDC Alternative Route 3-B could potentially impact 22 acres of the OSU-owned and -managed Lake Carl Blackwell if the Project is routed on the representative centerline. The tensioning areas associated with HVDC Alternative Route 3-B could potentially impact 0.2 acre of Lake Carl Blackwell and would have similar construction impacts as described for the HVDC Alternative Route 3-A. The corresponding Applicant Proposed Route Links 1, 2, and 3 have no impacts to recreation resources because no recreation resources are located in the representative ROW.

Hunting opportunities could be temporarily impacted by HVDC Alternative Route 3-B if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances as described in Section 3.12.6.2.3. These impacts would be limited to the immediate area of construction activity and would be short term in nature and, in some areas, may be mitigated by vegetation that is outside the ROW and not subject to clearing.

3.12.6.3.2.1.2.3 Alternative Route 3-C

HVDC Alternative Route 3-C could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir land, while corresponding Applicant Proposed Route Links 3, 4, 5, and 6 would impact 4 acres of Webbers Falls Lock and Dam. No tensioning areas are associated with HVDC Alternative Route 3-C. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

3.12.6.3.2.1.2.4 Alternative Route 3-D

HVDC Alternative Route 3-D could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir land if the Project is routed on the representative centerline, while corresponding Applicant Proposed Route Links 5 and 6 would affect 4 acres of Webbers Falls Lock and Dam. No tensioning areas are associated with the HVDC Alternative Route 3-D. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

The Webbers Falls Lock and Dam Reservoir is crossed by Alternative Route 3-D in Region 3 and is also crossed by several existing transmission lines:

- Gore to Weleetka 161kV
- Gore to Webbers Falls 115kV
- Eufaula to Gore 138kV
- Muskogee to Pittsburg 345kV

3.12.6.3.2.1.2.5 Alternative Route 3-E

HVDC Alternative Route 3-E could potentially impact 1 acre of the Webbers Falls Lock and Dam Reservoir land if the Project is routed on the representative centerline, while corresponding Applicant Proposed Route Links 5 and 6 would affect 4 acres of Webbers Falls Lock and Dam. No tensioning areas are associated with HVDC Alternative Route 3-E; tensioning areas associated with Applicant Proposed Route Links 5 and 6 would affect 1 acre of Webbers Falls Lock and Dam. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

3.12.6.3.2.1.3 Region 4

3.12.6.3.2.1.3.1 Alternative Route 4-A

HVDC Alternative Route 4-A would cross a section of the Mulberry River designated as Arkansas Natural and Scenic Rivers System by crossing the river near Clarksville, Arkansas. HVDC Alternative Route 4-A would cross a section of the Little Lee Creek designated as an Arkansas Natural and Scenic Rivers System by crossing the river near the Arkansas and Oklahoma state line. HVDC Alternative Route 4-A would cross a section of the Lee Creek designated on the NRI. The rivers would likely be spanned and structures would not be placed within the riparian zones.

HVDC Alternative Route 4-A would cross the Trail of Tears National Historic Trail in two places. HVDC Alternative Route 4-A would cross State Scenic Highway 220 and State Scenic Byway 540 (Boston Mountains Scenic Loop).

Corresponding Applicant Proposed Route Links 3, 4, 5, and 6 would affect 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA. Tensioning areas associated with Applicant Proposed Route Links 3, 4, 5, and 6 would affect 4 acres of the Frog Bayou WMA and cross the NRI segment of Lee Creek. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

3.12.6.3.2.1.3.2 Alternative Route 4-B

HVDC Alternative Route 4-B could potentially impact 230 acres of the Ozark National Forest and Ozark National Forest WMA if HVDC Alternative Route 4-B is routed on the representative centerline. Within the Ozark National Forest, approximately 102 acres are federal (public) land and approximately 157 acres are private inholdings. Recreation is most likely to occur on the federal portion of the Ozark National Forest; however, private landowners may allow hunting or other recreation within their lands.

HVDC Alternative Route 4-B would cross a section of the Mulberry River designated as Arkansas Natural and Scenic Rivers System by crossing the river near Clarksville, Arkansas. HVDC Alternative Route 4-B could potentially impact the sections of the Little Lee Creek designated as Arkansas Natural and Scenic Rivers System by crossing the river near the Arkansas and Oklahoma state line. HVDC Alternative Route 4-B would cross three sections of the Lee Creek that are designated on the NRI. The rivers would be spanned and structures would not be placed within the riparian zones. Tensioning areas would be located adjacent to the Mulberry River crossing location for HVDC Alternative Route 4-B.

HVDC Alternative Route 4-B would cross the Trail of Tears National Historic Trail in two places. HVDC Alternative Route 4-B would cross State Scenic Highway 220, and State Scenic Byway 23 (Pig Trail Scenic Byway). The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known.

Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit.

Corresponding Applicant Proposed Route Links 2, 3, 4, 5, 6, 7 and 8 would affect 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA and would cross Lee Creek. Tensioning areas associated with Applicant Proposed Route Links 2, 3, 4, 5, 6, 7, and 8 would affect 4 acres of the Frog Bayou WMA. There are no specific recreation areas, such as boat launches, campgrounds, or shooting ranges, that are located in HVDC Alternative Route 4-B.

3.12.6.3.2.1.3.3 Alternative Route 4-C

HVDC Alternative Route 4-C would cross the Trail of Tears and would span the trail. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. Alternative Route 4-C would cross State Scenic Highway 59. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 5 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.3.4 Alternative Route 4-D

HVDC Alternative Route 4-D could potentially impact the sections of the Mulberry River designated as Arkansas Natural and Scenic Rivers System by crossing the river near Clarksville, Arkansas. The river would likely be spanned and structures would not be placed within the riparian zones. HVDC Alternative Route 4-D would cross the Trail of Tears in two places and would span the trail. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known. HVDC Alternative Route 4-D would cross State Scenic Highway 59 and State Scenic Highway U.S. Highway 71. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. The construction of corresponding Applicant Proposed Route Links 4, 5, and 6 would affect 2 acres of the Ozark Lake WMA and 4 acres of the Frog Bayou WMA, and tensioning areas associated with these same links would affect 4 acres of the Frog Bayou WMA.

3.12.6.3.2.1.3.5 Alternative Route 4-E

HVDC Alternative Route 4-E could potentially impact the Big Piney Creek listed on the NRI by crossing the river near Clarksville, Arkansas. The river would likely be spanned and structures would not be placed within the riparian zones. HVDC Alternative Route 4-E would cross the Trail of Tears and would span the trail. Tensioning areas associated with HVDC Alternative Route 4-E would be adjacent to the Trail of Tears crossing and construction equipment may be located adjacent to the trail. The Trail of Tears locations mapped by the NPS are representative of the historic location of the trail and the extent of the trail at each crossing location is not known.

HVDC Alternative Route 4-E would cross State Scenic Highway Interstate 40 and State Scenic Byway 21 (Ozark Highlands Scenic Byway). Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 5 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.4 Region 5

3.12.6.3.2.1.4.1 Alternative Route 5-A

HVDC Alternative Route 5-A and tensioning areas associated with HVDC Alternative Route 5-A would cross the Arkansas Scenic 7 Byway. HVDC Alternative 5-A would cross State Scenic Byway 7 (Arkansas Scenic 7 Byway) and State Scenic Highway 27. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 1 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.4.2 Alternative Route 5-B

HVDC Alternative Route 5-B would cross two sections of the Cadron Creek listed on the NRI. HVDC Alternative Route 5-B would cross the following Arkansas State Scenic Highways: State Highway 9, U.S. Highway 65, State Highway 5 and State Highway 16. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. All features are expected to be spanned. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 3, 4, 5, and 6 because no recreation resources are located within the representative ROWs.

3.12.6.3.2.1.4.3 Alternative Route 5-C

HVDC Alternative Route 5-C would cross State Scenic Highway 16 and would span the road. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 6 and 7 because no recreation resources are located within the representative ROWs.

3.12.6.3.2.1.4.4 Alternative Route 5-D

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Route 5-D because no recreational resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 9 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.4.5 Alternative Route 5-E

HVDC Alternative Route 5-E would cross two sections of the Cadron Creek listed on the NRI, and State Scenic Highway 25, all are expected to be spanned. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 4, 5, and 6 because no recreation resources are located within the representative ROWs.

3.12.6.3.2.1.4.6 Alternative Route 5-F

HVDC Alternative Route 5-F would cross a section of the Cadron Creek listed on the NRI, and is expected to be spanned. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 5 and 6 because no recreation resources are located within the representative ROWs.

3.12.6.3.2.1.5 Region 6

3.12.6.3.2.1.5.1 Alternative Route 6-A

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Route 6-A because no recreation resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 2, 3, and 4 because no recreation resources are located within the representative ROWs.

3.12.6.3.2.1.5.2 Alternative Route 6-B

HVDC Alternative Route 6-B would cross Arkansas Scenic Highway 14 and is expected to span the road. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 3 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.5.3 Alternative Route 6-C

HVDC Alternative Route 6-C would cross the Crowley's Ridge Parkway National Scenic Byway and is expected to span the road. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. Corresponding Applicant Proposed Route Links 6 and 7 would affect 1 acre of the Singer Forest Natural Area/St. Francis Sunken

3.12.6.3.2.1.5.4 Alternative Route 6-D

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Route 6-D because no recreational resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 7 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.6 Region 7

3.12.6.3.2.1.6.1 Alternative Route 7-A

HVDC Alternative Route 7-A would cross State Scenic Highway 63 and Great River Road National Scenic Byway. Short term impacts during construction may include noise and visual disturbance which could diminish the quality of a recreational visit. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Link 1 because no recreation resources are located within the representative ROW.

3.12.6.3.2.1.6.2 Alternative Route 7-B, 7-C, and 7-D

No impacts to recreational lands or uses are anticipated from construction of HVDC Alternative Routes 7-B, 7-C, and 7-D because no recreational resources are located within the representative ROW. Likewise, no impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 3 and 4 (which correspond to Route 7-B) because no recreation resources are located within the representative ROWs. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 3, 4, and 5 (which correspond to Route 7-C) because no recreation resources are located within the representative ROWs. No impacts to recreational lands or uses are anticipated from construction of corresponding Applicant Proposed Route Links 4 and 5 (which correspond to HVDC Alternative Route 7-D) because no recreation resources are located within the representative ROW.

3.12.6.3.2.2 Operations and Maintenance Impacts

Operation and maintenance impacts from the HVDC alternative routes are similar to those for construction; however, they would be shorter in duration and at a smaller scale as discussed in Section 3.12.6.2.3.

3.12.6.3.2.3 Decommissioning Impacts

Decommissioning of HVDC transmission lines, as with any of the alternative routes, would be expected to have impacts similar to those described in Section 3.12.6.1 for common construction activities.

3.12.6.4 Best Management Practices

The Applicant has developed a comprehensive list of EPMs as part of the Project to minimize impacts to recreation resources. No other BMPs are recommended; however, some of the impacts discussed in this section are unavoidable. A complete list of EPMs for the Project is provided in Appendix F; those EPMs that would specifically minimize the potential for impacts on recreation resources are summarized in Section 3.12.6.1.

3.12.6.5 Unavoidable Adverse Impacts

Unavoidable impacts include the potential loss or alteration of recreational land and recreational uses of public or private lands that are located within the transmission line ROW due to restriction of public access from structure locations. Impacts to the setting of public recreational lands would be minimized by the EPMs, would be unavoidable and long-term, but would not be permanent in recreational areas that the Project crosses.

3.12.6.6 Irreversible and Irretrievable Commitment of Resources

All impacts related to recreational resources would cease with the end of the Project and would not be irreversible or irretrievable.

3.12.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Some direct short-term impacts to resources such as noise or visual disturbance, or restricted access to the recreation area during construction, would likely diminish the quality of a recreational visit. Long-term productivity of recreational areas could potentially decrease in recreational areas that the Project crosses.

3.12.6.8 Impacts from Connected Actions

3.12.6.8.1 Wind Energy Generation

The recreational lands within the WDZs may be affected by construction, operations and maintenance, and decommissioning of the Project. Indirect impacts to the visual setting would likely occur from construction, operations and maintenance, and decommissioning of wind facilities that would interconnect into the Project.

Recreational lands within the WDZs may experience short-term direct impacts during construction of wind projects. Noise, dust, and human activity, as well as vegetation clearing and turbine erection would cause short-term direct and indirect impacts to recreation. The quality of recreational activities such as sightseeing, fishing, hiking, bird watching, and wildlife viewing could be temporarily diminished due to construction noise and activity in the area and vegetation clearing. Recreation areas may also have long-term indirect visual impact from vegetation clearing (as needed) and the presence of turbines. The landscape in this region is flat with very few trees, which would make views of the wind turbines visible for a long distance.

Short-term direct impacts from construction-related noise and activity could be caused by the Project if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. Alternately, some wildlife may be temporarily attracted to cleared areas due to an increased availability of food. In such areas, food resources, such as nuts and seeds, left on the ground can be easily found by wildlife. Such displacement could improve hunting and wildlife viewing opportunities in some areas for a short period of time following clearing activities. After construction, operation of a wind project would not preclude hunting within the existing hunting boundaries or the wind farm boundary. Hunting is typically allowed on wind farms and public access is maintained. Access to hunting areas would likely not change as a result of developing a wind project; however, closures are possible during construction or maintenance for safety reasons. Noise and human activity could displace wildlife species from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances. Such displacement could improve hunting and wildlife viewing opportunities in some areas while reducing or temporarily eliminating opportunities in other areas.

Local parks located in WDZ-A lie within municipal boundaries and are unlikely to experience impacts from wind development. Wind farms may be visible from local parks, causing long-term visual disturbance until after decommissioning of the wind farm.

Palo Duro Reservoir is popular for fishing, sight-seeing, and water sports and is located in WDZ-B. Direct impacts from construction, such as noise and activity, are unlikely to affect the Palo Duro Reservoir because wind facilities are typically located away from open water. The components of the wind farm could have long-term impacts on the quality of recreational visits to Palo Duro Reservoir by adding unnatural components to scenic landscapes. The extent of these impacts would, however, depend on existing visual conditions in the affected areas, with impacts lower in those areas where other types of development are already present. Impacts would also vary based on the distance of the recreation area from the components. The reservoir is used for camping, and it may experience an influx of construction workers to the area who would reside in campers or RVs for the duration of construction. Only a small permanent workforce would be required for operation of the wind facilities. If workers are expected to stay in campers or RVs near the wind facility site, the developer would notify local RV park and camp site owners.

Millers Lake and County Road 18 hunting areas are located in Hansford County, Texas, in WDZ-B. Hunting opportunities could be temporarily impacted by the wind farm if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances.

No recreational areas are present in WDZ-C and WDZ-E through WDZ-K, so no impacts are expected.

Schultz WMA and Optima WMA are located in WDZ-D and are used primarily for hunting. Hunting opportunities could be temporarily impacted by the wind farm if wildlife species are displaced from areas near construction activities to suitable habitats adjacent to, but beyond the extent of, construction disturbances

Local parks located in WDZ-L lie within municipal boundaries and are unlikely to experience impacts from wind development because parks are unlikely to be targeted for development. Additionally, the wind industry has an established practice of avoiding local parks. It is assumed that wind energy developers would likely site wind farms to avoid direct impacts to parks and municipalities. Wind farms may be visible from local parks, causing long-term disturbance from potential views of the structures from these recreational resources until after decommissioning of the wind farm.

3.12.6.8.2 Optima Substation

No impacts to recreational lands or uses are anticipated from the future Optima Substation because no recreation resources are located within the substation siting area.

3.12.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

Potential recreation impacts associated with the upgrades could include disruption of recreational activities from temporary closures of recreation lands or access needed for construction activities for new or upgraded facilities. Long-term impacts are not likely for the required upgrades to existing facilities. The new transmission line could affect views from recreational areas, both from any new transmission lines and structures and from the changes in vegetation associated with the ROW. Recreational activities could be interrupted periodically by maintenance activities. Recreational users could be affected by the new transmission line if they opted for similar recreation areas without transmission lines or associated facilities, leading to increased visitation at other recreational sites in the area. Depending on its location, the new transmission line could interfere with access to existing recreation areas.

3.12.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. No disturbances would occur due to the Project, including disturbances to recreation resources. No disturbances due to construction vehicles, equipment, or access roads would affect recreation resources.

Impacts to recreation resources would be consistent with present levels of disturbance already occurring locally.

Contents

Tables

Figures Presented in Text*

*Other EIS figures presented in Appendix A.

3.13 Socioeconomics

3.13.1 Regulatory Background

Socioeconomic conditions and impacts are among "the effects on the human environment" to be discussed in an EIS. They are also commonly recognized and addressed as a concern under various federal, state, and local planning and management processes.

3.13.2 Data Sources

The socioeconomic analysis relies primarily on published information compiled by federal and state government agencies, supplemented by information from academic and private sources, as well as Project-specific data and information. Key federal and state data sources include the following:

- Federal agencies: U.S. Census Bureau, U.S. Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, and USDA
- State agencies: economic, demographic, labor, and revenue/taxation departments

3.13.3 Region of Influence

3.13.3.1 Region of Influence for the Project

The ROI for the socioeconomic analysis consists of the 33 counties that could potentially be directly affected by the Project components. The ROI is divided into seven regions for the purposes of analysis (Table 3.13-1; Figure 2.1-2 in Appendix A). The counties crossed by the AC collection system that are not crossed by the HVDC transmission line—Hansford, Ochiltree, and Sherman counties, Texas, and Cimarron County, Oklahoma—are not identified in Table 3.13-1, but are included as part of Region 1. Faulkner County, Arkansas, is not crossed by the Applicant Proposed Route and is therefore not identified in Table 3.13-1, but is included as part of Region 5.

Table 3.13-1:
States and Counties Crossed by the Applicant Proposed HVDC Transmission Line by Region

Region	State	County[1]	Miles
1	Oklahoma[2]	Texas, Beaver, Harper	115.5
2	Oklahoma	Woodward, Major, Garfield[3]	106.0
3	Oklahoma	Garfield[3], Kingfisher, Logan, Payne, Lincoln, Creek, Okmulgee, Muskogee[3]	161.7
4	Oklahoma	Muskogee[3], Sequoyah	43.5
	Arkansas	Crawford, Franklin, Johnson, Pope[3]	82.8
5	Arkansas[4]	Pope, Conway, Van Buren, Cleburne, White, Jackson[3]	112.8
6	Arkansas	Jackson[3], Poinsett[3], Cross	54.3
7	Arkansas	Poinsett[3], Mississippi	26.4
	Tennessee	Tipton, Shelby	16.4
		Total	719.4

1 Counties are generally listed from west to east by region.
2 Region 1 also includes the following counties that would be potentially crossed by the AC collection system routes: Hansford, Ochiltree, and Sherman counties, Texas, and Texas and Cimarron counties, Oklahoma.
3 Counties located in more than one region.
4 Region 5 also includes Faulkner County because it would be crossed by HVDC Alternative Routes 5-B and 5-D.

Where possible, the socioeconomic assessment references the seven regions, but the available socioeconomic data are typically based on geopolitical boundaries, usually counties, that do not directly correspond with the regions. As indicated in Table 3.13-1, the regions typically break mid-county, which results in several counties being located in more than one region. In addition, the proposed HVDC transmission line, as currently proposed, would be constructed in five approximately 140-mile-long segments that do not directly coincide geographically with the seven regions.

The following counties are located in more than one region: Garfield and Muskogee counties, Oklahoma, and Pope, Jackson, and Poinsett counties, Arkansas. Counties are assigned to one region for the purposes of analysis. Garfield, Muskogee, and Pope counties are assigned to the region that includes the majority of the HVDC transmission line located in that county: Regions 2, 3, and 5, respectively. The length of transmission line in Jackson and Poinsett counties is fairly evenly divided between two regions. These counties are included in the easternmost of the two regions: Regions 5 and 6, respectively.

The length of the HVDC transmission line ranges from 3.4 miles in Kingfisher County, Oklahoma, to 56 miles in Beaver County, Oklahoma (Table 3.13-2).

Table 3.13-2:
Miles Crossed by the Applicant Proposed HVDC Transmission Line by County and State

State/County[1]	Miles	State/County[1]	Miles	State/County[1]	Miles
Oklahoma		Arkansas		Tennessee	
Texas	23.8	Crawford	28.4	Shelby	5.0
Beaver	56.0	Franklin	19.8	Tipton	11.4
Harper	35.6	Johnson	27.8	Total	16.4
Woodward	32.4	Pope	27.1		
Major	52.2	Conway	21.6		
Garfield	22.2	Van Buren	13.2		
Kingfisher	3.4	Cleburne	23.5		
Logan	20.8	White	17.2		
Payne	35.7	Jackson	33.7		
Lincoln	10.0	Poinsett	31.5		
Creek	27.4	Cross	16.1		
Okmulgee	27.7	Mississippi	16.3		
Muskogee	39.5	Total	276.2		
Sequoyah	39.9				
Total	426.6				

1 Counties are generally listed from west to east by state.

Potential socioeconomic impacts would occur in the counties where the proposed facilities would be located and these counties form the ROI for the following analysis. Some impacts would also likely occur outside these counties. This is especially likely to be the case where larger communities are located in adjacent or nearby counties. These communities are likely to provide some local workers and also provide temporary housing for workers temporarily relocating to the area. Larger communities where these types of impact may occur include Metropolitan Statistical

Areas (MSAs) are part of or adjacent to the ROI. MSAs have at least one urbanized area with 50,000 or more residents, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties (OMB 2013). These areas represent larger communities that form regional markets for labor, goods and services, and information. MSAs typically include an urbanized node and economically related surrounding counties. The potentially affected MSAs are identified in Table 3.13-3.

Table 3.13-3:
MSAs that are Part of or Adjacent to the ROI

Region[1]	MSA	Principal City	Counties
3	Oklahoma City, OK	Oklahoma City, OK	Canadian, OK; Cleveland, OK; Grady, OK; Lincoln, OK[2]; Logan, OK[2]; McClain, OK; Oklahoma, OK
3	Tulsa, OK	Tulsa, OK	Creek, OK[2]; Okmulgee, OK[2]; Osage, OK; Pawnee, OK; Rogers, OK; Tulsa, OK; Wagoner, OK
4	Fort Smith, AR-OK	Fort Smith, AR	Crawford, AR[2]; Sebastian, AR; Le Flore, OK; Sequoyah, OK[2]
5	Little Rock-North Little Rock-Conway, AR	Little Rock, North Little Rock, Conway	Faulkner, AR[2]; Grant, AR; Lonoke, AR; Perry, AR; Pulaski, AR; Saline, AR
6	Jonesboro, AR	Jonesboro, AR	Craighead, AR; Poinsett, AR[2]
7	Memphis, TN-MS-AR	Memphis, TN	Crittenden, AR; Benton, MS; DeSoto, MS; Marshall, MS; Tate, MS; Tunica, MS; Fayette, TN; Shelby, TN[2]; Tipton, TN[2]

1 Identifies the region that includes counties that are part of the identified MSA.
2 County included in the ROI.

3.13.3.2 Region of Influence for Connected Actions

The ROI for wind energy generation, the future Optima Substation, and TVA upgrades is described in Section 3.1.1.

3.13.4 Affected Environment

3.13.4.1 Population

The 33 counties in the ROI had a total combined population of slightly more than 2 million people (2,055,103) in 2012, with almost half this total (934,654) concentrated in Shelby County, Tennessee. This county, located at the eastern end of the ROI includes the city of Memphis, which had an estimated 2012 population of 655,155 (USCB 2014a). As a result, slightly more than half the total population of the counties in the ROI is concentrated in Region 7. Total population in the remaining six regions in 2012 ranged from 51,652 in Region 1 (2.5 percent of the ROI total) to 348,517 in Region 3 (17.0 percent of the ROI total), closely followed by Region 5 with 334,750 (16.3 percent of the ROI total) (Table 3.13-4).

The western portion of the ROI is sparsely populated. The seven counties that compose Region 1 had an average population density of 5.4 people per square mile in 2012 (compared to a national average of 88.9). The city of Guymon, the county seat of Texas County, Oklahoma, is the largest community in Region 1, with an estimated population of just 11,930 in 2012 (USCB 2014a). Woodward and Major counties in Oklahoma (Region 2) are also relatively sparsely populated with 2012 population densities of 16.3 and 7.9 people/square mile, respectively. Average population densities in the other regions ranged from 30.8 people/square mile in Region 6 to 491.2 people/square mile in Region 7 (Table 3.13-4). MSAs adjacent to the ROI are identified by region in Table 3.13-3. There are no larger communities or MSAs within commuting distance of Region 1.

Population increased from 1990 to 2000 in all four states that are crossed by the ROI, with increases ranging from 10 percent (Oklahoma) to 23 percent (Texas), compared to a nationwide increase of 13 percent (Table 3.13-5). As detailed in Table 3.13.4, viewed by region, changes in population in the ROI from 1990 to 2000 ranged from no change in Region 2 to 24 percent in Region 5. Population in Region 1 increased by 5 percent over this period, but this was mainly due to a 22 percent increase in Texas County, Oklahoma, the most populated of the seven Region 1 counties. Five of the remaining six counties actually lost population in the 1990s.

Population also increased from 2000 to 2012 in all four states, with increases ranging from 10 percent (Oklahoma and Arkansas) to 25 percent (Texas), compared to a nationwide increase of 11 percent (Table 3.13-5). Viewed by region, changes over this period ranged from a net decrease of 6 percent in Region 6 to a 17 percent increase in Region 5 (Table 3.13-4).

Population is projected to increase nationwide and in all four states from 2012 to 2020 and from 2020 to 2030. In all cases, projected increases are expected to be smaller than those experienced over the past two decades (Table 3.13-5). Population projections for 2012 to 2020 vary substantially by region, ranging from a 6 percent decrease in Region 6 to a 20 percent increase in Region 5. Most counties are anticipated to see increases in population from 2020 to 2030 in all regions (Table 3.13-4).

Table 3.13-4:
Population by County and Region

Region	County[1]	2012 Population	2012 Population Density (people/square mile)	Population Change (Percent)		Projected Population Change[2] (Percent)	
				1990 to 2000	2000 to 2012	2012 to 2020	2020 to 2030
1	Hansford, TX	5,521	6.0	-8	3	11	11
	Ochiltree, TX	10,728	11.7	-1	19	7	13
	Sherman, TX	3,073	3.3	11	-4	7	9
	Cimarron, OK	2,451	1.3	-5	-22	-6	-7
	Texas, OK	20,620	10.1	22	3	7	5
	Beaver, OK	5,587	3.1	-3	-5	-6	-5
	Harper, OK	3,672	3.5	-12	3	-8	-7
	Region 1 Total	51,652	5.4	5	3	4	5
2	Woodward, OK	20,232	16.3	-3	9	3	5
	Major, OK	7,563	7.9	-6	0	0	-2
	Garfield, OK[1]	60,272	56.9	2	4	0	1
	Region 2 Total	88,067	27.0	0	5	0	1
3	Kingfisher, OK	14,965	16.7	5	7	3	3
	Logan, OK	41,982	56.4	17	24	10	9
	Payne, OK	77,125	112.6	11	13	9	8
	Lincoln, OK	34,106	35.8	10	6	9	9
	Creek, OK	69,934	73.6	11	4	8	8
	Okmulgee, OK	39,770	57.0	9	0	2	2
	Muskogee, OK[1]	70,635	87.2	2	2	6	3
	Region 3 Total	348,517	60.7	9	7	7	6

Table 3.13-4:
Population by County and Region

Region	County[1]	2012 Population	2012 Population Density (people/square mile)	Population Change (Percent)		Projected Population Change[2] (Percent)	
				1990 to 2000	2000 to 2012	2012 to 2020	2020 to 2030
4	Sequoyah, OK	41,945	62.3	15	8	10	10
	Crawford, AR	61,670	104.0	25	16	19	6
	Franklin, AR	18,110	29.7	19	2	2	9
	Johnson, AR	25,554	38.7	25	12	14	5
	Region 4 Total	147,279	58.1	21	11	14	7
5	Pope, AR[1]	61,853	76.1	19	14	15	-4
	Conway, AR	21,203	38.4	6	4	6	-8
	Van Buren, AR	17,223	24.3	16	6	8	7
	Cleburne, AR	25,849	46.7	24	7	10	15
	Faulkner, AR	113,730	175.5	43	32	36	4
	White, AR	77,007	74.4	23	15	17	0
	Jackson, AR[1]	17,885	28.2	-3	-3	-2	-25
	Region 5 Total	334,750	67.7	24	17	20	1
6	Poinsett, AR[1]	24,506	32.3	4	-4	-4	3
	Cross, AR	17,891	29.0	2	-8	-10	10
	Region 6 Total	42,397	30.8	3	-6	-6	6
7	Mississippi, AR	46,388	51.5	-10	-11	-12	-9
	Shelby, TN	934,654	1224.7	9	4	2	1
	Tipton, TN	61,399	134.0	36	20	12	12
	Region 7 Total	1,042,441	491.2	9	4	2	1

1 Counties located in more than one region are assigned to one region for the purposes of analysis. Garfield and Muskogee counties, Oklahoma, and Pope County, Arkansas, are assigned to the region that includes the majority of the HVDC transmission line located in that county. Garfield County is assigned to Region 2, Muskogee County to Region 3, and Pope County to Region 5. The length of transmission line in Jackson and Poinsett counties, Arkansas, is fairly evenly divided between two regions. These counties are included in the first region from east to west. Jackson County is assigned to Region 5 and Poinsett County to Region 6. This distribution of counties by region is used throughout the following analysis.

2 Population projections for Texas, Oklahoma, and Tennessee counties are based on 2010 Census data. Projections for Arkansas for 2020 are based on 2010 Census data; 2030 Arkansas projections are based on 2000 Census data.

Sources: Oklahoma DOC (2012), Texas State Data Center (2012), USCB (2002, 2010, 2014a), Institute for Economic Advancement (2010, 2012), Center for Business and Economic Research (2013)

Table 3.13-5:
Population by State

State	2012 Population	2012 Population Density (people /square mile)	Population Change (Percent)		Projected Population Change (Percent)	
			1990 to 2000	2000 to 2012	2012 to 2020	2020 to 2030
Texas	26,060,796	99.8	23	25	5	7
Oklahoma	3,786,152	55.2	10	10	6	7
Arkansas	2,936,822	56.4	14	10	12	3
Tennessee	6,404,240	155.3	17	13	8	8
United States	313,914,040	88.9	13	11	6	7

Sources: Oklahoma DOC (2012), Texas State Data Center (2012), USCB (2002, 2010, 2014a), Institute for Economic Advancement (2010, 2012), Center for Business and Economic Research (2013)

3.13.4.2 Economic Conditions

The USDA Economic Research Service (ERS) developed a set of county typology codes designed to capture differences in economic and social characteristics at the county level (USDA ERS 2008). These codes consist of six non-overlapping categories of economic dependence (farming, mining, manufacturing, federal/state government, services, and non-specialized) and seven overlapping categories of policy-relevant themes, including non-metropolitan recreation area and retirement destination. The economic dependence categories are assigned based on the share of average annual labor and proprietors' income and/or the share of total employment associated with the identified categories. The ERS assigned all counties to one of the economic dependence categories based on data from 1998 to 2000 (Table 3.13-6).

The ERS typology identified all seven counties in Region 1 as farming-dependent. The majority of the other counties were identified as non-specialized, with six counties identified as manufacturing-dependent, two counties identified as federal/state government-dependent, two counties identified as services-dependent, and one identified as mining-dependent (Table 3.13-6). In addition, three counties, all located in Region 5, were identified as retirement destination counties, and one other was identified as a non-metropolitan county.

Total employment increased from 2001 to 2011in all four states crossed by the ROI, as well as nationwide (Table 3.13-6). Viewed by region, changes in total employment from 2001 to 2011 ranged from a 7 percent decrease in Region 6 to a 14 percent increase in Region 1. Annual unemployment rates in 2012 by region ranged from 3.3 percent and 3.7 percent in Regions 2 and 1, respectively, to 9.1 percent in Region 7 (Table 3.13-6). The national unemployment rate in 2012 was 8.1 percent (Table 3.13-7). Average per capita income by region ranged from $28,698 (equivalent to 66 percent of the U.S. per capita income) in Region 4 to $44,558 in Region 1, which is slightly higher than the U.S. average per capita income (Table 3.13-6).

Table 3.13-6:
Economic Conditions by County and Region

Region	County	Economic Type	Employment[1] 2011	Employment[1] Percent Change 2001 to 2011	Annual Unemployment Rate 2012	Per-Capita Income 2012	Per-Capita Income Percent of U.S. Per Capita-Income
1	Hansford, TX	Farming	3,712	8	3.9	56,221	129%
	Ochiltree, TX	Farming	7,687	29	3.3	52,628	120%
	Sherman, TX	Farming	1,790	0	4.6	58,431	134%
	Cimarron, OK	Farming	2,059	-4	3.6	44,090	101%
	Texas, OK	Farming	14,051	16	4.7	36,504	83%
	Beaver, OK	Farming	4,156	16	2.5	44,876	103%
	Harper, OK	Farming	2,144	1	2.9	36,897	84%
	Region 1		35,599	14	3.7	44,558	102%
2	Woodward, OK	Non-specialized	11,883	-16	2.8	44,285	101%
	Major, OK	Mining	5,310	13	3.2	43,005	98%
	Garfield, OK	Federal/state government	38,682	16	3.5	43,705	100%
	Region 2		55,875	7	3.3	43,778	100%
3	Kingfisher, OK	Non-specialized	9,922	12	3.2	43,162	99%
	Logan, OK	Non-specialized	22,398	32	4.4	40,789	93%
	Payne, OK	Federal/state government	46,646	4	4.8	36,186	83%
	Lincoln, OK	Non-specialized	14,540	3	5.1	32,633	75%
	Creek, OK	Manufacturing	30,356	5	6.0	34,619	79%
	Okmulgee, OK	Non-specialized	15,329	4	7.7	30,674	70%
	Muskogee, OK	Non-specialized	38,706	-1	6.4	33,653	77%
	Region 3		177,897	6	5.6	35,236	81%
4	Sequoyah, OK	Non-specialized	14,629	6	8.5	29,010	66%
	Crawford, AR	Non-specialized	27,152	14	7.4	28,880	66%
	Franklin, AR	Non-specialized	7,001	-5	6.7	31,837	73%
	Johnson, AR	Manufacturing	11,866	6	6.8	25,520	58%
	Region 4		60,648	8	7.5	28,698	66%
5	Pope, AR	Non-specialized	34,057	7	7.1	29,929	68%
	Conway, AR	Non-specialized	11,160	8	7.6	34,140	78%
	Van Buren, AR	Non-specialized [3]	6,162	0	8.9	31,285	72%
	Cleburne, AR	Manufacturing[2]	12,889	8	7.2	36,510	83%
	Faulkner, AR	Non-specialized[2]	55,844	22	6.6	34,472	79%
	White, AR	Services[2]	36,823	10	8.0	31,059	71%
	Jackson, AR	Non-specialized	7,900	-9	9.6	33,022	76%
	Region 5		164,835	12	7.3	32,742	75%
6	Poinsett, AR	Manufacturing	8,125	-13	7.8	33,832	77%
	Cross, AR	Non-specialized	8,314	0	8.2	33,687	77%
	Region 6		16,439	-7	8.0	33,771	77%

Table 3.13-6:
Economic Conditions by County and Region

Region	County	Economic Type	Employment[1]		Annual Unemployment Rate 2012	Per-Capita Income	
			2011	Percent Change 2001 to 2011		2012	Percent of U.S. Per Capita-Income
7	Mississippi, AR	Manufacturing	24,179	-5	10.0	33,822	77%
	Shelby, TN	Services	624,006	1	9.1	42,409	97%
	Tipton, TN	Manufacturing[2]	15,794	3	8.9	36,825	84%
	Region 7		663,979	0	9.1	41,698	95%

1 Total employment includes self-employed individuals. Employment data are by place of work, not place of residence and, therefore, include people who work in the area but do not live there. Employment is measured as the average annual number of jobs, both full- and part-time, with each job that a person holds counted at full weight.
2 Retirement destination county
3 Non-metropolitan recreation county
Sources: BEA (2012, 2013a), BLS (2014a), USDA ERS (2008)

Table 3.13-7:
Economic Conditions by State

State/Country	Employment				Annual Unemployment Rate 2012	Per-Capita Income	
	2001	2011	Net Change 2001 to 2011	Percent Change 2001 to 2011		2012	Percent of U.S. Per-Capita Income
Texas	12,211,172	14,611,475	2,400,303	19.7	6.8	35,437	81%
Oklahoma	2,009,727	2,167,780	158,053	7.9	5.2	40,620	93%
Arkansas	1,482,678	1,552,597	69,919	4.7	7.3	38,752	89%
Tennessee	3,433,689	3,591,298	157,609	4.6	8.0	42,638	97%
United States	165,510,200	175,834,700	10,324,500	6.2	8.1	43,735	na

na = not applicable
Sources: BEA (2012, 2013a), BLS (2014b)

3.13.4.3 Agriculture

Land in farms accounted for 78 percent of the total land area in Texas in 2007 and 80 percent of total land area in Oklahoma. In Arkansas and Tennessee land in farms accounted for about 42 percent of each state's total land area (Table 3.13-8). Average farm size ranged from 138 acres in Tennessee to 527 acres in Texas. Livestock, poultry, and their products accounted for the majority of agricultural products sold by market value in all four states, ranging from 56 percent of the total in Tennessee to 80 percent in Oklahoma (Table 3.13-8).

Table 3.13-8:
Summary of Agriculture by State

County	Number of Farms	Land in Farms (acres)	Percent of Total Land Area	Average Farm Size (acres)	Market Value of Agriculture Products Sold ($ million)	Total Market Value of Agricultural Products Sold	
						Crops (%)	Livestock, Poultry, and Products (%)
Arkansas	49,346	13,872,862	42	281	7,509	39	61
Oklahoma	86,565	35,087,269	80	405	5,806	20	80
Tennessee	79,280	10,969,798	42	138	2,617	44	56
Texas	247,437	130,398,753	78	527	21,001	31	69

Source: USDA (2009)

Viewed by region, land in farms ranged from 38 percent in Region 3 to 98 percent in Region 1. Land in farms also accounted for almost all (94 percent) of the total land area in Region 2 (Table 3.13-9). Average farm size by region ranged from 198 acres in Region 5 to 1,397 acres in Region 1. Average farm size by county ranged from 116 acres in Crawford County, Arkansas, to 2,419 acres in Hansford County, Texas. All seven counties in Region 1 had average farm sizes larger than 1,000 acres (Table 3.13-9).

Table 3.13-9:
Summary of Agriculture by County and Region

Region	County	Number of Farms	Land in Farms (acres)	Percent of Total Land Area	Average Farm Size (acres)	Market Value of Agriculture Products Sold ($ million)	Total Market Value of Agricultural Products Sold	
							Crops (%)	Livestock, Poultry, and Products (%)
1	Hansford, TX	242	585,286	99	2,419	590	15	85
	Ochiltree, TX	382	579,476	99	1,517	395	(D)	(D)
	Sherman, TX	362	584,196	99	1,614	449	23	77
	Cimarron, OK	557	1,044,528	89	1,875	262	18	82
	Texas, OK	1,038	1,205,978	92	1,162	780	15	85
	Beaver, OK	952	1,128,871	97	1,186	188	19	81
	Harper, OK	580	616,947	93	1,064	123	9	91
	Region 1	4,113	5,745,282	95	1,397	2,787	17	83
2	Woodward, OK	892	783,200	98	878	79	(D)	(D)
	Major, OK	967	517,334	85	535	113	11	89
	Garfield, OK	1,082	663,431	98	613	76	38	62
	Region 2	2,941	1,963,965	94	668	268	22	78
3	Kingfisher, OK	1,002	566,212	99	565	117	22	78
	Logan, OK	1,241	403,810	85	325	49	18	82
	Payne, OK	1,567	356,765	81	228	39	13	87
	Lincoln, OK	2,300	487,858	80	212	38	10	90
	Creek, OK	1,900	377,437	62	199	20	17	83
	Okmulgee, OK	1,449	294,324	66	203	21	18	82
	Muskogee, OK	1,845	374,372	72	203	53	27	73
	Region 3	11,304	2,860,778	78	253	335	19	81

Table 3.13-9:
Summary of Agriculture by County and Region

Region	County	Number of Farms	Land in Farms (acres)	Percent of Total Land Area	Average Farm Size (acres)	Market Value of Agriculture Products Sold ($ million)	Total Market Value of Agricultural Products Sold	
							Crops (%)	Livestock, Poultry, and Products (%)
4	Sequoyah, OK	1,352	231,943	54	172	59	9	91
	Crawford, AR	1,026	119,227	31	116	59	18	82
	Franklin, AR	759	152,822	39	201	112	3	97
	Johnson, AR	607	105,820	25	174	135	3	97
	Region 4	3,744	609,812	38	163	365	6	94
5	Pope, AR	1,080	153,693	30	142	149	96	4
	Conway, AR	994	187,142	53	188	134	8	92
	Van Buren, AR	566	114,270	25	202	16	92	8
	Cleburne, AR	905	129,815	37	143	56	3	97
	Faulkner, AR	1,341	190,089	46	142	20	29	71
	White, AR	2,199	411,404	62	187	119	71	29
	Jackson, AR	445	302,125	74	679	107	96	4
	Region 5	7,530	1,488,538	47	198	600	60	40
6	Poinsett, AR	418	340,704	70	815	154	99	1
	Cross, AR	364	282,963	72	777	112	99	1
	Region 6	782	623,667	71	798	266	99	1
7	Mississippi, AR	369	461,328	80	1,250	196	100	0
	Shelby, TN	600	92,299	19	154	24	89	11
	Tipton, TN	610	170,182	58	279	37	93	7
	Region 7	1,579	723,809	53	458	256	98	2

(D) Data suppressed by the Census to prevent disclosure of an individual respondent's data.
Source: USDA (2009)

The market value of agricultural products sold in 2007 ranged from $256 million in Region 7 to $2,787 in Region 1. Viewed by county, total market value in 2007 ranged from $16 million in Van Buren County, Arkansas, to $780 million in Texas County, Oklahoma (Table 3.13-9). Total market value and the relative distribution between crops and livestock, poultry, and their products are shown graphically by county in Figure 3.13-1. Livestock, poultry, and their products accounted for the majority of agricultural products sold by market value in the counties that compose Regions 1 through 4, and some of the counties in Region 5. Crops accounted for the vast majority of the value of agricultural products sold in the counties in Regions 6 and 7, as well as Pope, White, and Jackson counties in Region 5 (Figure 3.13-1).

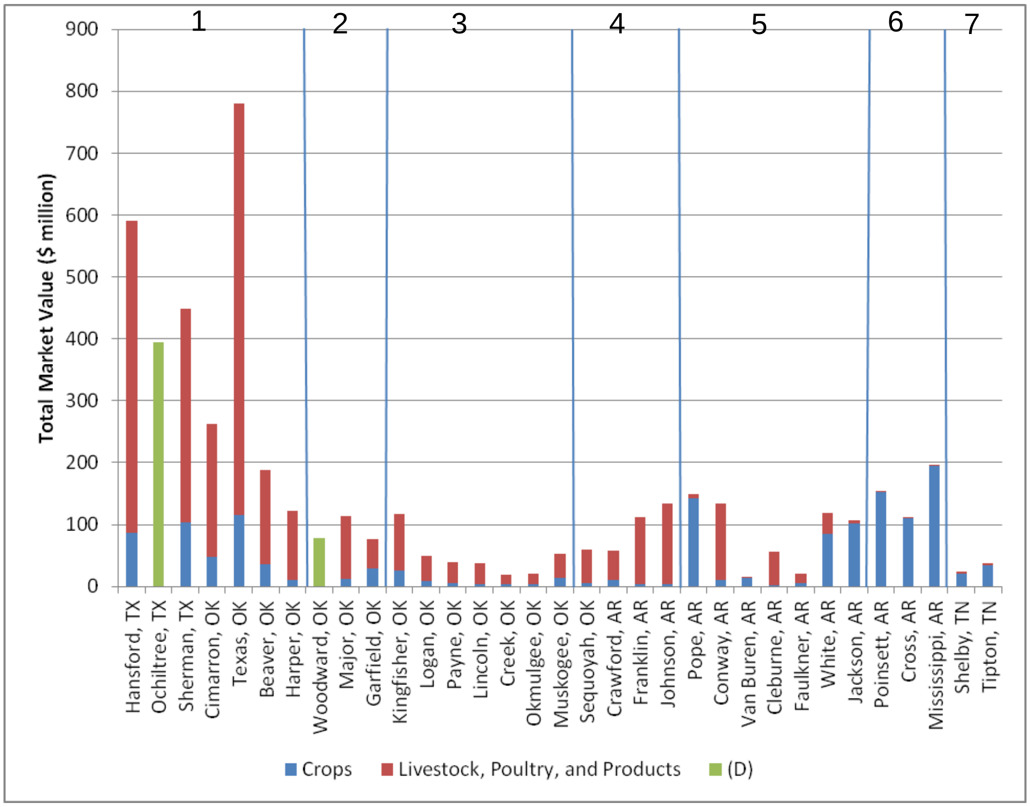

Figure 3.13-1: Total Market Value of Agricultural Products Sold, 2007

Source: USDA (2009)
(D) Data on type of product suppressed by the Census to prevent disclosure of an individual respondent's data.
The numbers (1 through 7) across the top of this figure represent the seven regions that compose the ROI.

3.13.4.4 Housing

Construction of the HVDC transmission line is expected to draw local and workers from outside the region (import workers). The majority of import workers would likely temporarily relocate to the ROI and adjacent communities, especially the larger metropolitan areas that offer quality of life amenities and are within commuting distance to portions of the Project.

Housing resources are summarized for the ROI by county and region in Table 3.13-10. Data on housing units are estimates for 2012 prepared by the USCB (2014b). The Census Bureau defines a housing unit as a house, an apartment, a mobile home or trailer, a group of rooms, or a single room occupied or intended to be occupied as separate living quarters. Viewed by region, these estimates suggest that limited rental housing is available in Region 1, with less than 100 units available in six of the seven counties that compose the region for a combined estimated total of 370 units (Table 3.13-10). Rental housing is also relatively limited in Regions 2 and 6, with 862 and 908 units available, respectively. The relatively low number of units available in Region 6 is largely due to the small size of the region, which consists of just two counties.

Data on hotel and motel rooms and recreational vehicle (RV) spaces were compiled by Clean Line (2013) from various state resources (identified in Table 3.13-10). These data are partial estimates and likely underestimate the number of hotel and motel rooms and RV spaces present. Numbers of hotel and motel rooms estimated by Clean Line range from 238 in Region 5 to 11,827 in Region 7. Other regions with relatively low estimates of hotel and motel rooms include Region 1 (1,093 rooms), Region 2 (1,604 rooms), and Region 4 (1,868 rooms).

Table 3.13-10:
Housing Resources by County and Region

	Housing Units 2012[1]				
County	Total	Rental Vacancy Rate	Units Available for Rent	Hotel and Motel Rooms[2]	RV Spaces[3]
Hansford, TX	2,338	5.9	25	29	37
Ochiltree, TX	4,048	0.0	0	252	124
Sherman, TX	1,188	5.1	13	22	N/A
Cimarron, OK	1,583	8.3	30	44	17
Texas, OK	8,221	6.0	174	697	24
Beaver, OK	2,674	11.1	75	36	7
Harper, OK	1,907	15.0	53	13	26
Region 1	21,959	6.1	370	1,093	235
Woodward, OK	8,827	17.0	437	775	25
Major, OK	3,673	3.0	22	35	9
Garfield, OK	26,809	4.7	403	794	60
Region 2	39,309	7.2	862	1,604	94
Kingfisher, OK	6,404	5.9	89	54	N/A
Logan, OK	17,037	7.9	280	315	63
Payne, OK	33,912	7.0	1,108	1,008	292
Lincoln, OK	15,168	6.9	216	183	13
Creek, OK	29,755	6.9	478	164	142
Okmulgee, OK	17,898	7.2	352	316	154
Muskogee, OK	30,937	6.9	670	832	15
Region 3	151,111	7.0	3,193	2,872	679
Sequoyah, OK	18,662	7.0	341	656	193
Crawford, AR	25,985	8.5	598	690	53
Franklin, AR	8,022	8.6	159	114	194
Johnson, AR	11,265	7.1	237	408	N/A
Region 4	63,934	7.8	1,335	1,868	440
Pope, AR	25,555	11.2	878	1,075	177
Conway, AR	9,703	16.8	436	243	142
Van Buren, AR	10,315	1.0	16	105	49
Cleburne, AR	15,765	8.6	228	501	94
Faulkner, AR	46,571	9.9	1,668	1,459	83
White, AR	32,356	7.1	708	995	68
Jackson, AR	7,624	12.2	273	171	20
Region 5	147,889	9.6	4,207	4,549	633

Table 3.13-10:
Housing Resources by County and Region

County	Housing Units 2012[1]			Hotel and Motel Rooms[2]	RV Spaces[3]
	Total	Rental Vacancy Rate	Units Available for Rent		
Poinsett, AR	10,957	11.9	464	96	27
Cross, AR	7,876	16.6	444	142	24
Region 6	18,833	13.8	908	238	51
Mississippi, AR	20,559	10.4	842	714	18
Shelby, TN	398,847	13.8	22,003	11,043	375
Tipton, TN	23,189	8.3	513	70	N/A
Region 7	442,595	13.4	23,358	11,827	393

N/A —Number of units not available

1 Data on housing units were compiled from USCB (2014b).

2 Data for hotel and motel rooms were compiled by Clean Line (2013) from the following sources:
Texas—Source Strategies, Inc.
Oklahoma—Oklahoma Tourism and Recreation Department
Arkansas—Arkansas Department of Parks and Tourism
Tennessee—Memphis Convention and Visitors Bureau

3 Data for RV spaces were compiled by Clean Line (2013) from the following sources:
Texas—Texas Office of Economic Development and Tourism
Oklahoma—Oklahoma Tourism and Recreation Department
Arkansas—Arkansas Department of Parks and Tourism
Tennessee—Memphis Convention and Visitors Bureau

Comprehensive data on hotel and motel rooms are available for the three Texas counties in Region 1. These data indicate that the supply of rooms is extremely limited in these counties. Number of rooms varied from just 22 and 29 rooms located in Hansford and Sherman counties, respectively, and 252 rooms located in Ochiltree County while occupancy rates varied by season in 2013, with rates generally higher in the third quarter than in the earlier part of the year (Source Strategies 2013b). Occupancy rates in the third quarter (July, August, and September) were 75.0 percent, 74.1 percent, and 49.4 percent in Hansford, Ochiltree, and Sherman counties, respectively (Source Strategies 2013a, 2013b).

Estimates of RV spaces range from 51 in Region 6 to 679 in Region 3 (Table 3.13-10). Comprehensive data are not available on these types of resources, and the estimates presented in Table 3.13-10, while representing the best available information, likely understate the number of RV spaces in many cases. However, information from various state resources suggests that RV facilities are more likely to be available in the vicinity of the more populated parts of the ROI and adjacent communities.

The data presented in Table 3.13-10 are for those counties within the ROI only. Additional housing resources within daily commuting distance are available in adjacent larger communities along parts of the ROI. This is the case for Regions 3 through 7 where communities within commuting distance generally include Oklahoma City and Tulsa in Oklahoma, Fort Smith, Little Rock, and Jonesboro in Arkansas, and Memphis in Tennessee. Located in Shelby County, Memphis is part of Region 7, but is also within daily commuting distance of parts of Region 6.

3.13.4.5 Community Services

3.13.4.5.1 Police and Fire Services

Summary data for law enforcement and fire departments are presented by county and region in Table 3.13-11. These data compiled by Clean Line (2013) provide a partial overview of resources available in each county. In general, the number of police and fire departments is directly related to the overall size and population of the county, as well as the number of communities. Multiple law enforcement agencies and providers exist in the potentially affected counties, including state patrol, county sheriffs, and local police departments. In many cases, mutual aid agreements allow agencies to support one another in emergency situations. Multiple fire departments and districts also provide fire protection and suppression services in the ROI. Many of these fire departments and districts are at least partially staffed by volunteers and tend to be housed in stations and fire houses in the larger communities.

Table 3.13-11:
Summary of Law Enforcement and Fire Departments by County and Region

Region	County	Police Departments	Fire Departments
1	Hansford, TX	3	1
	Ochiltree, TX	3	1
	Sherman, TX	3	1
	Cimarron, OK	3	2
	Texas, OK	6	4
	Beaver, OK	1	4
	Harper, OK	3	3
	Region 1	22	16
2	Woodward, OK	3	3
	Major, OK	3	4
	Garfield, OK	6	4
	Region 2	12	11
3	Kingfisher, OK	5	4
	Logan, OK	5	6
	Payne, OK	7	5
	Lincoln, OK	9	6
	Creek, OK	10	10
	Okmulgee, OK	7	10
	Muskogee, OK	9	12
	Region 3	52	53
4	Sequoyah, OK	8	17
	Crawford, AR	5	7
	Franklin, AR	3	6
	Johnson, AR	2	4
	Region 4	18	34
5	Pope, AR	5	10
	Conway, AR	2	9
	Van Buren, AR	1	6
	Cleburne, AR	3	7

Table 3.13-11:
Summary of Law Enforcement and Fire Departments by County and Region

Region	County	Police Departments	Fire Departments
	Faulkner, AR	5	14
	White, AR	8	19
	Jackson, AR	5	7
	Region 5	29	72
6	Poinsett, AR	7	9
	Cross, AR	3	5
	Region 6	10	14
7	Mississippi, AR	8	10
	Shelby, TN	9	10
	Tipton, TN	4	7
	Region 7	21	27

Source: Clean Line (2013)

3.13.4.5.2 Medical Facilities

Medical facilities in the ROI are identified in Table 3.13-12. Minor Project-related injuries would be treated at local medical facilities or emergency rooms. Workers with more serious injuries would be taken to one of the major hospitals in the general vicinity.

Table 3.13-12:
Medical Facilities by County and Region

Region	Hospital	County[1]	Beds	Services
1	Hansford County Hospital	Hansford	4	Emergency Services
	Ochiltree General Hospital	Ochiltree, TX	25	Emergency Services
	Stratford Hospital District	Sherman	42	Emergency Services
	Cimarron Memorial Hospital	Cimarron	25	Emergency Room Services
	Memorial Hospital of Texas County	Texas	47	Emergency Room Services
	Beaver County Memorial Hospital	Beaver	24	Emergency Room Services
	Harper County Community Hospital	Harper	25	Emergency Room Services
2	Woodward Regional Hospital	Woodward	73	Emergency Room Services
	Okeene Municipal Hospital[2]	Blaine	17	Emergency Room Services
	Integtis Bass Baptist Health Center	Garfield	162	Emergency Room Services, Medical Helicopter Pad
	St. Mary's Regional Medical Center	Garfield	263	Emergency Room Services
3	Kingfisher Regional Hospital	Kingfisher	25	Emergency Room Services
	Mercy Hospital Logan County	Logan	25	Emergency Room Services
	Hillcrest Hospital Cushing	Payne	99	Emergency Room Services
	Stillwater Medical Center	Payne	120	Emergency Room Services, Medical Helicopter Pad
	Prague Community Hospital	Lincoln	25	Emergency Room Services
	Stroud Regional Medical Center	Lincoln	25	Emergency Room Services
	Bristow Medical Center	Creek	30	Emergency Room Services

Table 3.13-12:
Medical Facilities by County and Region

Region	Hospital	County[1]	Beds	Services
	Drumright Regional Hospital	Creek	15	Emergency Room Services
	St John Sapulpa	Creek	25	Emergency Room Services
	Okmulgee Memorial Hospital	Okmulgee	66	Emergency Room Services
	Eastar Health System	Muskogee	320	Emergency Room Services, Medical Helicopter Pad
	Intensiva Hospital of Eastern Oklahoma	Muskogee	30	Emergency Room Services
	Solara Hospital Muskogee	Muskogee	41	Emergency Room Services
4	Sequoyah Memorial Hospital	Sequoyah	41	Emergency Room Services
	Summit Medical Center	Crawford	103	Emergency Room Services
	Mercy Hospital Turner Memorial	Franklin	25	Emergency Room Services
	Johnson Regional Medical Center	Johnson	80	Emergency Room Services
5	St Mary's Regional Medical Center	Pope	170	Emergency Room Services, Medical Helicopter Pad
	River Valley Medical Center[3]	Yell	25	Emergency Room Services
	St Vincent Morrilton	Conway	35	Emergency Room Services
	Ozark Health	Van Buren	25	Emergency Room Services
	Baptist Health Medical Center Heber Springs	Cleburne	25	Emergency Room Services
	Conway Regional Medical Center	Faulkner	149	Emergency Room Services, Medical Helicopter Pad
	White County Medical Center	White	193	Emergency Room Services, Medical Helicopter Pad
	Harris Hospital	Jackson	133	Emergency Room Services
6	Crossridge Community Hospital	Cross	15	Emergency Room Services
7	South Mississippi County Regional Medical Center	Mississippi	25	Emergency Room Services
	Baptist Memorial Hospital	Shelby	706	Emergency Room Services, Medical Helicopter Pad
	Delta Medical Center	Shelby	243	Emergency Room Services
	Methodist Healthcare Memphis Hospital	Shelby	1,537	Emergency Room Services
	Saint Francis Bartlett Medical Center	Shelby	100	Emergency Room Services
	Select Specialty Hospital Memphis	Shelby	30	Emergency Room Services
	St Francis Hospital	Shelby	519	Emergency Room Services
	Baptist Memorial Hospital Tipton	Tipton	100	Emergency Room Services

N/A—not applicable
1 No hospitals were identified in Major County, Oklahoma, or Poinsett County, Arkansas.
2 Okeene Municipal Hospital is located in Blaine County, Oklahoma, approximately 7 miles south of Major County.
3 River Valley Medical Center is located in Yell County, Arkansas, across the Arkansas River from Pope County.
Source: Clean Line (2013)

Medical facilities are limited in the Texas counties located in Region 1. The Ochiltree General Hospital, a Level IV trauma center, provides emergency services in Ochiltree County. Emergency medical services are provided in Sherman County by the Stratford EMS, which is part of the Stratford Hospital District. Additional hospitals are located in neighboring counties, including the Moore County Hospital, south of Sherman County, which provides 24-hour emergency services.

Most counties in Oklahoma within the ROI have at least one hospital that provides emergency services. Major County is the one exception. Emergency room services are, however, available at the Okeene Municipal Hospital in neighboring Blaine County, about 7 miles south of the county line. All but one of the counties in Arkansas has at least one hospital with emergency services. Poinsett County is the exception. Medical services are available in nearby counties. At least six hospitals serve the Memphis area in Tennessee and provide emergency services and a substantial number of beds (Table 3.13-12).

3.13.4.5.3 Education

The total number of school districts, schools, students, and teachers are summarized by county in Table 3.13-13. Student/teacher ratios are also summarized by county and region. Student/teacher ratios, calculated by dividing the total number of students by the total number of full-time equivalent teachers, are a common measure used to assess the overall quality of a school. The national average student teacher ratio for the 2011 school year (the most recent available data) was 16.0. The statewide average ratios in Texas, Oklahoma, Arkansas, and Tennessee were 15.4, 16.1, 15.1, and 14.8, respectively (NEA 2012).

All three Texas counties in Region 1 had student/teacher ratios below the state and national average (fewer students per teacher). This was also the case with Oklahoma counties in Regions 1 through 4, all of which had student/teacher ratios below the corresponding state and national averages, ranging from 6.9 in Beaver County (Region 1) to 11.8 in Logan and Payne counties (Region 3). Average student/teacher ratios in the Arkansas counties in the ROI range from 9.7 in Van Buren County to 15.0 in Faulkner County (both in Region 5), below the corresponding and state averages. Student/teacher ratios in the two Tennessee counties (Region 7) were higher than the statewide and national averages (Table 3.13-13). The numbers, presented here by county and region, are averages. Student/teacher ratios vary by school district and by school in each county, as well as by grade within each school.

Table 3.13-13:
Schools by County and Region

Region	County	Number of School Districts	Total Number of Schools	Total Number of Students	Total Number of Teachers	Student/Teacher Ratio (Average)[1]
1	Hansford, TX	3	7	1,341	136	9.9
	Ochiltree, TX	2	8	2,646	213	12.4
	Sherman, TX	3	7	1,498	130	11.5
	Cimarron, OK	3	9	864	119	7.3
	Texas, OK	9	23	4,475	460	9.7
	Beaver, OK	4	8	1,111	160	6.9
	Harper, OK	2	4	766	94	8.1
	Region 1	26	66	12,701	1,312	9.7

Table 3.13-13:
Schools by County and Region

Region	County	Number of School Districts	Total Number of Schools	Total Number of Students	Total Number of Teachers	Student/Teacher Ratio (Average)[1]
2	Woodward, OK	4	12	3,809	343	11.1
	Major, OK	4	9	1,539	186	8.3
	Garfield, OK	8	31	10,664	926	11.5
	Region 2	16	52	16,012	1,455	11.0
3	Kingfisher, OK	6	16	3,428	397	8.6
	Logan, OK	4	13	4,647	395	11.8
	Payne, OK	7	28	10,757	914	11.8
	Lincoln, OK	9	23	5,736	584	9.8
	Creek, OK	15	39	13,047	1,209	10.8
	Okmulgee, OK	9	23	6,890	621	11.1
	Muskogee, OK	10	35	13,488	1,174	11.5
	Region 3	60	177	57,993	5,294	11.0
4	Sequoyah, OK	12	26	8,616	796	10.8
	Crawford, AR	5	23	11,232	757	14.8
	Franklin, AR	4	9	3,225	238	13.6
	Johnson, AR	3	10	4,383	321	13.7
	Region 4	24	68	27,456	2,112	13.0
5	Pope, AR	5	22	9,665	756	12.8
	Conway, AR	4	10	3,121	265	11.8
	Van Buren, AR	3	8	2,231	229	9.7
	Cleburne, AR	4	9	3,355	280	12.0
	Faulkner, AR	6	36	18,157	1,211	15.0
	White, AR	9	28	12,764	946	13.5
	Jackson, AR	2	6	2,162	188	11.5
	Region 5	33	119	51,455	3,875	13.3
6	Poinsett, AR	5	15	4,227	361	11.7
	Cross, AR	2	6	3,446	250	13.8
	Region 6	7	21	7,673	611	12.6
7	Mississippi, AR	6	21	8,035	631	12.7
	Shelby, TN	4	52	45,705	2,742	16.7
	Tipton, TN	2	14	11,437	744	15.4
	Region 7	12	87	65,177	4,117	15.8

1 Data are average student/teacher rations per county. Rates vary within each county by school district and school.
Source: Clean Line (2013)

3.13.4.6 Tax Revenues

3.13.4.6.1 Sales, Use, and Lodging Taxes

The state of Texas levies a 6.25 percent sales and use tax on all retail and rental sales. In addition, counties and cities have the option to levy additional combined sales and use taxes of up to 2 percent within their jurisdictions. Most counties in the state of Texas levy an additional 0.5 percent sales and use tax. None of the counties in the ROI currently levies a sales and use tax, and no sales tax receipts were received in these counties in July 2013 (Table 3.13-14).

Table 3.13-14:
Sales and Use Tax by Texas County, 2013

Region	State/County	Sales Tax (Percent)	Monthly Sales Tax Receipts (July 2013)
	Texas	6.25	N/A
1	Hansford	0.00	$0
	Ochiltree	0.00	$0
	Sherman	0.00	$0

Source: Texas Comptroller of Public Accounts (2013a)

The state of Oklahoma levies a sales, use, and lodging tax of 4.5 percent. Sales tax is levied on goods and services purchased within the state. Use tax is imposed on goods purchased tax-free outside Oklahoma for use in Oklahoma (see Oklahoma Administrative Code Title 710, Chapter 65). County and other local jurisdictions are allowed to levy additional sales, use, and lodging taxes within their jurisdictions. Additional sales, use, and lodging taxes levied by counties in Oklahoma in the ROI range from 0.25 percent in Major County (Region 2) to 2 percent in Beaver and Harper counties (Region 1) (Table 3.13-15).

Table 3.13-15:
Sales and Use Tax by Oklahoma County, 2013

Region	State/County	Sales, Use, and Lodging Tax Rates (Percent) (July 2013)	Monthly Sales Tax and Use Tax Receipts (July 2013)
	Oklahoma	4.50	N/A
1	Cimarron	2.00	40,541
	Texas	1.00	372,896
	Beaver	2.00	399,427
	Harper	2.00	136,669
2	Woodward	1.33	357,400
	Major	0.25	22,890
	Garfield	0.35	334,300
3	Kingfisher	0.75	202,916
	Logan	1.00	502,660
	Payne	0.81	1,369,669
	Lincoln	1.00	283,726
	Creek	1.00	482,373
	Okmulgee	1.25	273,060
	Muskogee	0.65	427,365
4	Sequoyah	1.42	311,253

Source: Oklahoma Tax Commission (2013a, 2013b)

The state of Arkansas levies a sales and use tax of 6.5 percent. Counties and other local jurisdictions are also able to levy additional sales and use taxes within their jurisdictions. Current county rates range from 0.5 percent in Faulkner County (Region 5) to 2.25 percent in Jackson County (Region 5) (Table 3.13-16).

Table 3.13-16:
Sales and Use Tax by Arkansas County, 2013

Region	State/County	Sales and Use Tax Rate (Percent)	Monthly Sales and Use Tax Receipts (July 2013)
	Arkansas	6.50	N/A
4	Crawford, AR	1.00	$516,053
	Franklin, AR	1.50	$208,843
	Johnson, AR	1.00	$236,443
5	Pope, AR	1.00	$830,995
	Conway, AR	1.75	$530,926
	Van Buren, AR	2.00	$316,123
	Cleburne, AR	1.63	$588,197
	Faulkner, AR	0.50	$1,808,224
	White, AR	1.50	$1,472,778
	Jackson, AR	2.25	$380,013
6	Poinsett, AR	1.25	$241,922
	Cross, AR	2.00	$372,256
7	Mississippi, AR	2.00	$1,044,722

Source: Arkansas Department of Finance and Administration (2013a, 2013b)

The state of Tennessee levies a 7.00 percent sales and use tax. Shelby and Tipton counties both levy an additional 2.25 percent sales and use tax (Table 3.13-17).

Table 3.13-17:
Sales and Use Tax by Tennessee County, 2014

Region	State/County	Sales Tax Rate	Monthly Sales Tax Receipts (January 2014)
	Tennessee	7.00	N/A
7	Shelby	2.25	$28,059,228
	Tipton	2.25	$856,828

Source: Tennessee Department of Revenue (2014a, 2014b)

3.13.4.6.2 Property and Ad Valorem Taxes

Texas has no state property tax. Property taxes are local taxes levied by local governments and used to pay for schools, streets, police, fire protection, and other services. Counties, cities, school districts, and various special districts collect and spend property taxes. The governing body of each of these local governments determines the amount of property taxes it wants to raise and sets its own tax rate. Most local governments contract with their county's tax assessor-collector to collect the tax on their behalf (Texas Comptroller of Public Accounts 2014). Utility property in Texas is assessed by each county using a unitary method that can include one or more of the cost, income, or market approach to valuation. These approaches are briefly summarized below.

Each county is served by an appraisal district responsible for determining the value of the county's taxable property. Property taxes are calculated by applying a millage rate to the assessed value of the property. One mill equals one-thousandth of a dollar. If the assessed value of a property is $1,000 and the millage rate is 1.00, then the tax on that property is $1.00. Millage rates for the three Texas counties in Region 1 are shown in Table 3.13-18.

Table 3.13-18:
Millage Tax Rate by Texas County, 2012

Region	County	Millage Rate[1]
1	Hansford	4.131
	Ochiltree	4.200
	Sherman	4.392

1. Property tax rates are presented per $100 of assessed value in Texas. The applicable rates have been adjusted here so they are per $1,000 of assessed value.

Source: Texas Comptroller of Public Accounts (2013b)

Property or ad valorem taxes in Oklahoma are local taxes. County officials typically value property, set tax rates, and collect tax revenues. Oklahoma uses a fractional assessment system, which means the assessed value is less than 100 percent of the property's fair cash value. Once an assessed value has been determined, the various taxing entities apply their tax rate or millage rate to this assessed value to determine the total amount of ad valorem tax.

Special rules apply to the valuation of public service corporations in Oklahoma. Public service corporations, which include electric companies, are valued at the state level by the Oklahoma Tax Division. Fair cash value of public service corporation property may be determined by any combination of three possible approaches: an income approach, which converts projected future income or cash flow into an estimate of present value; the stock and debt or market approach, which estimates the price obtainable from the sale of all outstanding capital stock and funded debt; or the cost approach, which uses either the original cost or historical cost less depreciation. Assessed values are determined for public service corporation property by applying an assessment rate of 22.85 percent to the fair cash value (Oklahoma SBE 2006).

Property taxes are then calculated by applying a millage rate to the assessed value of the property. Millage rates vary within a county based on location and the corresponding jurisdictions levying a property tax. Table 3.13-19 presents a range of potential millage rates for each of the Oklahoma counties within the ROI.

Table 3.13-19:
Millage Tax Rates by Oklahoma County, 2012

Region	State/County	Low Millage[1]	High Millage[1]
1	Cimarron	61.74	67.29
	Texas	55.60	80.73
	Beaver	52.19	67.94
	Harper	57.00	86.36
2	Woodward	63.64	93.10
	Major	78.89	100.12
	Garfield	80.29	103.61
3	Kingfisher	77.99	105.94
	Logan	76.29	119.76
	Payne	73.67	102.61
	Lincoln	73.75	99.11

Table 3.13-19:
Millage Tax Rates by Oklahoma County, 2012

Region	State/County	Low Millage[1]	High Millage[1]
	Creek	73.98	120.55
	Okmulgee	80.68	97.29
	Muskogee	74.96	100.40
4	Sequoyah	68.50	84.33

1. Millage rates are presented as a range. Actual rates vary by district.
Source: OKAssessor (2012)

In Arkansas, local government entities, such as county and city governments, school districts, fire and emergency medical districts, sewer districts, and other special taxing districts, are allowed to levy *ad valorem* property taxes on real and personal property within their jurisdictions. The Arkansas Public Service Commission's Tax Division determines ad valorem assessments for transmission lines throughout the state. The Division uses a unitary appraisal method that considers the value of the company as a whole to determine assessed values (APSC 2010). An assessment rate of 20 percent is applied to the fair cash value to determine the total assessed value of the property (Arkansas Assessment Coordination Department 2012).

The average overall millage rates for Arkansas counties within the ROI are presented in Table 3.13-20. These rates consist of the combined total of the average school district, average city, and average county millage rate for each county. The combined rate for Cleburne County (41.94), for example, consists of an average school district millage of 34.86 plus the average city millage of 1.98 plus the average county millage of 5.10 (Arkansas Assessment Coordination Department 2013).

Table 3.13-20:
Millage Tax Rates by Arkansas County, 2012

Region	State/County	Millage Rate
4	Crawford, AR	49.11
	Franklin, AR	46.79
5	Johnson, AR	47.96
	Pope, AR	45.98
	Conway, AR	46.53
	Van Buren, AR	43.90
	Cleburne, AR	41.94
	Faulkner, AR	48.70
	White, AR	43.01
	Jackson, AR	46.65
6	Poinsett, AR	44.47
	Cross, AR	49.89
7	Mississippi, AR	49.70

Source: Arkansas Assessment Coordination Department (2013)

The Tennessee Comptroller of the Treasury is responsible for assessing public utility property throughout the state for property tax purposes, employing a unitary method to assess the value of the company as a whole. Utility property is assessed at 55 percent of fair market value with an appraisal ratio applied for each county to equalize values throughout the state (Tennessee SBE 2013, 2014). Average millage rates in Shelby and Tipton counties in Tennessee in 2012 were 4.06 and 2.34, respectively (Tennessee Comptroller of the Treasury 2013). These tax rates are expressed as an amount per $100 of assessed value and set by the governing body of the county (Tennessee SBE 2013). Adjusted to be per $1,000 of assessed value, the average millage rates in Shelby and Tipton counties in Tennessee in 2012 were 40.6 and 23.4, respectively.

3.13.5 Connected Actions

3.13.5.1 Wind Energy Generation

The Applicant has identified a total of 12 WDZs within a 40 mile radius of the Oklahoma Converter Station Siting Area spread over six counties, three in Oklahoma (Beaver, Cimarron, and Texas) and three in Texas (Hansford, Ochiltree, and Sherman (Table 3.13-21). These counties are the ROI for Region 1 and baseline information is presented for each of these counties in Section 3.13.4.

Table 3.13-21:
Total WDZ Acres by State and County

Wind Development Zone	Oklahoma[1]			Texas[1]			Total[2]
	Beaver	Cimarron	Texas	Hansford	Ochiltree	Sherman	
A				14	95		109
B				125			125
C				52		109	161
D			69				69
E			47				47
F			110			2	112
G		125	62				187
H			116				116
I			105				105
J	70		22				92
K	92				1		93
L				39	127		166
Total	162	125	531	230	223	111	1,382

1 WDZ areas are summarized in thousands of acres.
2 Totals may not sum due to rounding.

3.13.5.2 Optima Substation

The ROI for the future Optima Substation for socioeconomics is Texas County, Oklahoma. This county is part of the ROI for Region 1; baseline information is presented for this county in Section 3.13.4.

3.13.5.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed in the impact sections that follow.

3.13.6 Socioeconomic Impacts

3.13.6.1 Methodology

The socioeconomic analysis is based primarily on secondary data compiled from federal, state, and local government agencies. Key sources of data include the U.S. Census Bureau, the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor Statistics, USDA, and various state agencies.

The potential effects of the converter stations, AC collection system, Applicant Proposed Route, and the DOE Alternatives, including the Arkansas Converter Station Alternative Siting Area and DOE alternative routes, were evaluated with respect to the key aspects of the socioeconomic environment, including demographic characteristics, economic conditions, housing, property values, community services, and tax revenues. These evaluations employ different resource-specific analysis methods that are described in their respective sections.

Key Project-related variables used in the socioeconomic analysis include projected construction employment and expenditures. Operations-related employment and expenditures are also used. Construction employment and spending estimates are disaggregated by county where appropriate, primarily based on the share of overall construction that would occur in that county. Information is primarily presented by region (Figure 2.1-2 in Appendix A) consistent with other resources and with consideration given to an ROI more consistent with socioeconomic analysis of linear facilities. These estimates represent the best available information and a reasonable approximation of the likely distribution of potential impacts, but should not be considered precise forecasts. In most cases, estimated impacts may be compared with the existing conditions data presented in the preceding part of this section.

Total regional economic impacts are estimated at the state level using direct-effect multipliers for earnings and for employment from the U.S. Bureau of Economic Analysis' RIMS II regional modeling system (BEA 2013b). The multipliers from this model are based on regional information derived from databases analyzing commercial, industrial, and household spending patterns and relationships. Multipliers are provided for different sectors of the economy. Multipliers for the construction and utilities sectors are used in this analysis. Total economic impacts consist of direct, indirect, and induced impacts.

Direct impacts represent the change in economic activity resulting from the initial round of inputs purchased by the project. In this case, direct impacts consist of the employment and related earnings directly associated with construction, operations and maintenance, and decommissioning phases of the Project. These direct impacts generate economic activity elsewhere in the local economy through the multiplier effect, as initial changes in demand "ripple" through the economy and generate indirect and induced impacts. *Indirect* impacts are generated by the expenditures by suppliers who provide goods and services to the construction project or for project operations. *Induced* impacts are generated by the spending of households benefiting from the additional wages and business income earned through related direct or indirect activities.

Economic impacts to agriculture in eastern Arkansas are assessed using information from the Arkansas Delta Agricultural Economic Impact Study prepared for this project. This agricultural economic impact study, which focuses on four counties in eastern Arkansas: Jackson (Regions 5 and 6), Cross (Region 6), Poinsett (Regions 6 and 7), and Mississippi (Region 7), is included as Appendix J to this EIS.

Clean Line will implement the EPMs listed in Appendix F to avoid or minimize potential impacts from construction of the Project. Those EPMs that would help avoid or minimize potential socioeconomic impacts include the following:

- GE-6: Clean Line will restrict vehicular travel to the ROW and other established areas within the construction, access, or maintenance easement(s).
- GE-8: Access controls (e.g., cattle guards, fences, gates) will be installed, maintained, repaired, replaced, or restored as required by regulation, road authority, or as agreed to by landowner.
- GE-11: Clean Line will conduct construction, operation, and maintenance activities to minimize the creation of dust. This may include measures such as limitations on equipment, speed, and/or travel routes utilized. Water, dust palliative, gravel, combinations of these, or similar control measures may be used. The Applicant will implement measures to minimize the transfer of mud onto public roads.
- GE-12: Clean Line will avoid remedial structures (e.g., capped areas, monitoring equipment, or treatment wells) on contaminated sites, Superfund sites, CERCLA remediation areas, and other similar areas. Workers will use appropriate protective equipment and appropriate safe working techniques when working at or near contaminated sites.
- GE-15: Waste generated during construction or maintenance, including solid waste, petroleum waste, and any potentially hazardous materials will be removed and taken to an authorized disposal facility.
- GE-20: Clean Line will conduct construction and scheduled maintenance activities on the facilities during daylight hours, except in rare circumstances that may include, for example, to address emergency or unsafe situations, to avoid adverse environmental effects, to minimize traffic disruptions, or to comply with regulatory or permit requirements.
- GE-21: Clean Line will maintain construction equipment in good working order. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions will be repaired or adjusted.
- GE-22: Clean Line will impose speed limits during construction for access roads (e.g., to reduce dust emissions, for safety reasons, and for protection of wildlife).
- GE-23: Clean Line will maximize the distance between stationary equipment and sensitive noise receptors consistent with engineering design criteria.
- GE-24: Clean Line will minimize the number and distance of travel routes for construction equipment near sensitive noise receptors.
- GE-25: Clean Line will turn off idling equipment when not in use.
- GE-27: Clean Line will minimize compaction of soils and rutting through appropriate use of construction equipment (e.g., low ground pressure equipment and temporary equipment mats).
- GE-28: Hazardous materials and chemicals will be transported, stored, and disposed of according to federal, state, or local regulations or permit requirements.
- AG-1: Clean Line will avoid or minimize adverse effects to surface and subsurface irrigation and drainage systems (e.g., tiles). The Applicant will work with landowners to minimize the placement of structures in locations that would interfere with the operation of irrigation systems.
- AG-2: Agricultural soils temporarily impacted by construction, operation, or maintenance activities will be restored to pre-activity conditions. For example, soil remediation efforts may include decompaction, recontouring, liming, tillage, fertilization, or use of other soil amendments.
- AG-4: Clean Line will work with landowners and/or tenants to identify specialty agricultural crops or lands (e.g., certified organic crops or products that require special practices, techniques, or standards) that may require protection during construction, operation, or maintenance. The Applicant will avoid and/or minimize impacts that could jeopardize standards or certifications that support specialty croplands or farms.

- AG-5: Clean Line will work with landowners and/or tenants to consider potential impacts to current aerial spraying or application (i.e., crop dusting) of herbicides, fungicides, pesticides, and fertilizers within or near the transmission ROW. The Applicant will avoid or minimize impacts to aerial spraying practices when routing and siting the transmission line and related infrastructure.
- AG-6: Clean Line will work with landowners to develop compensation for lost crop value caused by construction and/or maintenance.
- LU-1: Clean Line will work with landowners and operators to ensure that access is maintained as needed to existing operations (e.g., to oil/gas wells, private lands, agricultural areas, pastures, hunting leases).
- LU-2: Clean Line will minimize the frequency and duration of road closures.
- LU-3: Clean Line will work with landowners to avoid and minimize impacts to residential landscaping.
- LU-4: Clean Line will coordinate with landowners to site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.
- W-15: Clean Line will seek to procure water from municipal water systems where such water supplies are within a reasonable haul distance; any other water required will be obtained through permitted sources or through supply agreements with landowners.

Additionally, Clean Line proposes to implement the following plans that would help minimize other potential socioeconomic impacts:

- Transportation and Traffic Management Plan. This plan will describe measures designed to avoid and/or minimize adverse effects associated with the existing transportation system.
- Spill Prevention, Control and Countermeasures Plan. This plan will describe the measures designed to prevent, control, and clean up spills of hazardous materials.
- Construction Security Plan. This plan will describe measures designed to avoid and/or minimize adverse effects associated with breaches in Project security during construction including terrorism, sabotage, vandalism, and theft. The plan will include provisions describing how the Project construction team will coordinate with state and local law enforcement agencies during construction to improve Project security and facilitate security incident response, if required.
- Communications Plan. This plan will incorporate all forms of communication with the public, with elements implemented as appropriate during different phases of the Project. Elements of this plan are described in Section 3.1.2.

3.13.6.2 Impacts Associated with the Applicant Proposed Project

3.13.6.2.1 Population

3.13.6.2.1.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.1.1.1 Construction Impacts

The Applicant proposes to locate new AC/DC converter stations in Texas County, Oklahoma, and either Shelby County or Tipton County, Tennessee. The Oklahoma converter station would be located in Region 1. The Tennessee converter station would be located in Region 7.

Employment during construction of each converter station is expected to follow a bell-shaped pattern, with an average of 138 workers over a 32-month construction period and a peak of 232 to 242 workers from months 12 to 17 (Figure 3.13-2).

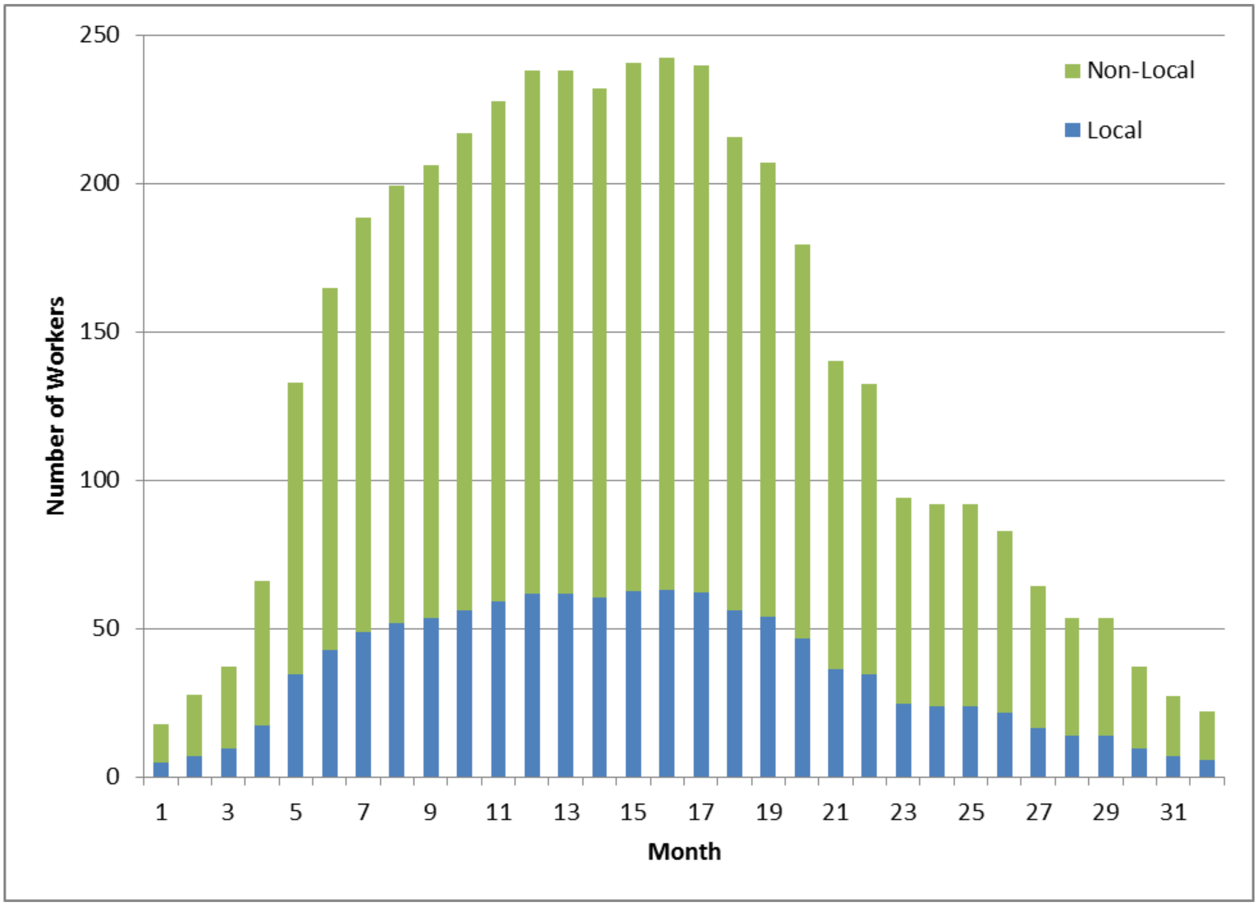

Figure 3.13-2: Estimated Construction Workforce per Converter Station by Month and Local/Non-Local Workers

Source: Clean Line (2014a)

Inclusive of pre-construction activities, an estimated total of 296 workers are expected to be hired over the construction phase of each converter station, with 26 percent of this total (approximately 77 workers) expected to be hired locally (i.e., workers who normally reside within daily commuting distance of the applicable converter station site). Daily commuting distance is assumed to be up to a 2 hour drive each way for the purposes of this analysis (Clean Line 2014a). Some workers would be employed for the full duration of construction, but many workers would be employed for shorter periods based on their trades. Local hires would include surveyors and workers employed in site development, fence installation, and traffic control. Local hires would compose a smaller share of the workforce for more specialized tasks, such as equipment footings and cable trenching, conduits, and grounding and steel structure erection and electrical equipment installation. The proportion of non-local workers onsite at any one time would vary over the construction period as the mix of labor categories and skills varies.

For the purposes of analysis, the share of non-local workers (219 workers) is assumed to be 74 percent for the full duration of convertor station construction, resulting in an average of 102 non-local workers employed over the 32-month construction period, with an estimated peak of 171 to 179 non-local workers employed during months 12 to

17. In addition, 10 percent of non-local workers temporarily relocating to the Project sites are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be two adults and one school-age child (Clean Line 2013).

Based on these assumptions, an estimated average of 123 people would be expected to temporarily relocate to the vicinity of each converter station for the full duration of the 32-month construction period, with the number of people who would relocate increasing to 215 during the peak construction period (months 12 to 17). The average increase would be equivalent to approximately 0.6 percent, 0.2 percent, and less than 0.1 percent of the existing (2012) population in Texas, Tipton, and Shelby counties, respectively. The peak increase would be equivalent to approximately 1 percent, 0.3 percent, and less than 0.1 percent of the respective existing (2012) populations in Texas, Tipton, and Shelby counties. Very few, if any, of the non-local workers employed during the construction phase of the converter stations would be expected to permanently relocate to the affected areas, so it is unlikely that construction of the converter stations would result in any long-term changes in population.

3.13.6.2.1.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to employ up to 15 workers. These estimated staffing levels would have no noticeable impact on existing population levels in the potentially affected counties.

3.13.6.2.1.1.3 Decommissioning Impacts

The labor force required to decommission each converter station would be similar to that required for construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.1.2 AC Collection System

3.13.6.2.1.2.1 Construction Impacts

The counties crossed by the AC collection system routes and mileage of each route within each county are provided in Table 2.1-5. The AC collection system routes are all located in Region 1 (Figure 2.1-2 in Appendix A).

Assuming that workforce requirements are similar to those estimated for the HVDC transmission line, the average length of an AC collection system route, 34.4 miles, would require an average of 51 workers over a 24-month construction period, with an estimated peak of 71 workers. Adjusted to reflect the length of each alternative, the respective average and peak number of workers would range from 20 and 28 for AC Collection System Routes SE-2 and SW-1 (13.4 miles) to 83 and 116 for AC Collection System Route NW-2 (56.0 miles).

Estimated temporary increases in population are shown by alternative and county in Table 3.13-22. These estimates assume that 74 percent of the workforce would be non-local for the duration of the Project. In addition, approximately 10 percent of non-local workers are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be three, two adults and one school-age child. Population is distributed for the purposes of analysis based on the length of the line in each county.

Table 3.13-22:
Estimated Temporary Change in Population During Construction by AC Collection System Routes and County

County/Route	E-1	E-2	E-3	NE-1	NE-2	NW-1	NW-2	SE-1	SE-2	SE-3	SW-1	SW-2	W-1
Temporary Change in Population Based on Average Employment Forecast[1]													
Beaver, OK	5	20	21	0	0	0	0	0	0	4	0	0	0
Texas, OK	33	32	31	39	35	66	71	25	5	32	5	20	27
Cimarron, OK	0	0	0	0	0	2	3	0	0	0	0	0	0
Hansford, TX	0	0	0	0	0	0	0	3	13	0	13	4	0
Ochiltree, TX	0	0	0	0	0	0	0	26	0	28	0	0	0
Sherman, TX	0	0	0	0	0	0	0	0	0	0	0	25	0
Total	38	52	52	39	35	68	74	53	18	64	18	49	27
Temporary Change in Population Based on Peak Employment Forecast[1]													
Beaver, OK	7	28	30	0	0	0	0	0	0	6	0	0	0
Texas, OK	46	45	44	55	48	93	99	34	7	45	7	28	38
Cimarron, OK	0	0	0	0	0	3	4	0	0	0	0	0	0
Hansford, TX	0	0	0	0	0	0	0	4	18	0	18	6	0
Ochiltree, TX	0	0	0	0	0	0	0	36	0	40	0	0	0
Sherman, TX	0	0	0	0	0	0	0	0	0	0	0	35	0
Total	53	73	73	55	48	95	103	74	25	90	25	68	38

1 Totals may not sum due to rounding.

Viewed by AC collection system route, projected changes in population during peak construction would range from about 25 (AC Collection System Routes SE-2 and SW-1) to about 103 (AC Collection System Route NW-1) (Table 3.13-22). The largest expected temporary increase (103) is equivalent to about 0.2 percent of the total existing (2012) population in Region 1 (51,652) (Table 3.13-4). The largest expected gain for an individual county would be a temporary increase of 99 in Texas County, Oklahoma, under AC Collection System Route NW-2. This estimated increase of 99 people is equivalent to about 0.5 percent of Texas County's total 2012 population (20,620) (Table 3.13-4).

Four to six AC transmission lines are expected to be built. Assuming that six alternatives with an average length of 34.4 miles are constructed, average and peak population increases of about 271 and 379 people, respectively, approximately 0.5 percent and 0.7 percent of the total 2012 population in Region 1, would result.

Very few, if any, of the non-local workers employed during the construction phase of the AC collection system routes would be expected to permanently relocate to the affected areas, so it is unlikely that construction of the AC collection system would result in any long-term changes in population.

3.13.6.2.1.2.2 Operations and Maintenance Impacts

Combined operation of the HVDC and AC transmission lines in Region 1 is expected to employ 15 workers based in Guymon, Oklahoma (Texas County). This number is not expected to vary based on which AC collection system routes are selected. This estimated staffing level would have no noticeable impact on existing population levels in Texas County, which had a total estimated population of 20,620 in 2012 (Table 3.13-4).

3.13.6.2.1.2.3 Decommissioning Impacts

Decommissioning of the AC transmission lines would require a labor force approximately equal to that needed for its construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.1.3 HVDC Applicant Proposed Route

3.13.6.2.1.3.1 Construction Impacts

Overall construction of the 720-mile-long HVDC transmission line is expected to take 30 months. Total employment by month is expected to range from 110 in month 30 to a peak of 1,288 in month 12, with an average monthly employment of 690 (Appendix F). The transmission line would be constructed in five 140-mile-long segments, each taking 24 months to complete. The estimated workforce is shown by month and task for a representative 140-mile segment in Figure 3.13-3. Total employment by month for each 140-mile segment is expected to range from 55 workers in month 24 to a peak of 290 workers in months 4, 5, and 6, with an average monthly employment of 207.

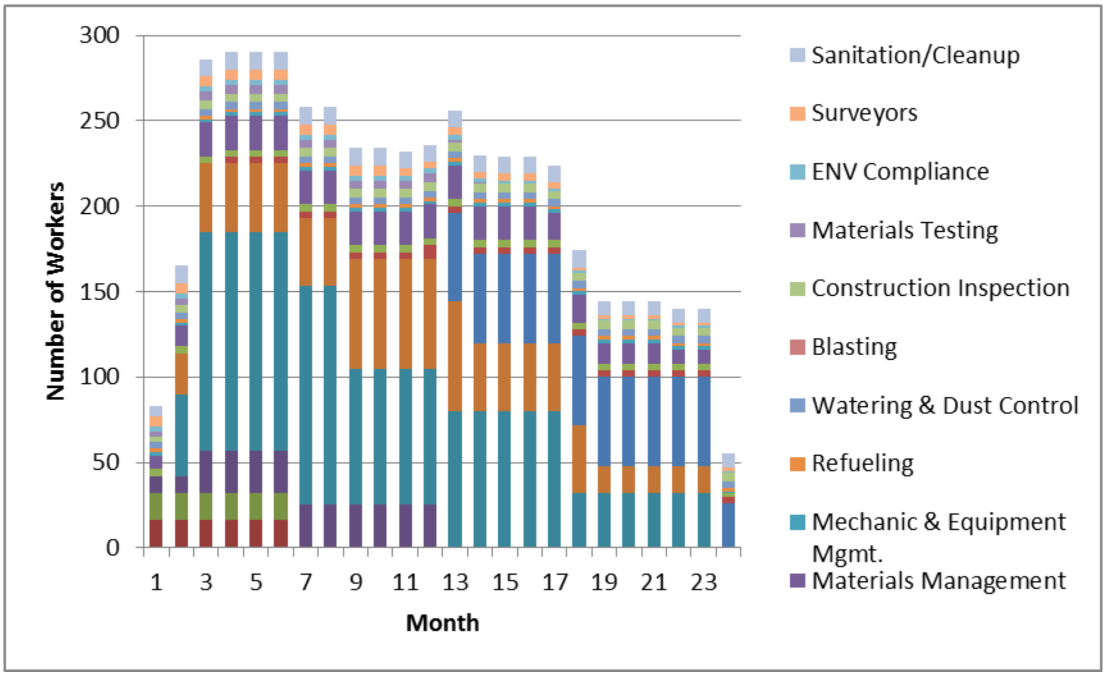

Figure 3.13-3: Estimated Construction Workforce per 140-mile Segment of HVDC Transmission Line by Month and Task

Source: Clean Line (2013)

Figure 3.13-4 identifies the expected local/non-local breakdown for an average 140-mile segment by month. Local workers are those who normally reside within commuting distance of the work sites. Non-local workers would temporarily relocate to the ROI or immediate vicinity for the duration of their employment; some workers would possibly commute home on weekends, depending on the location of their primary residence. Individual non-local workers may also relocate along the ROI and between segments depending on their assignment.

Tasks expected to mainly employ local workers include ROW clearing, access road and pad construction, foundation construction, restoration, and materials management. Tasks expected to be dominated by non-local workers are related to specialty trades and include tower lacing (assembly), tower setting (erection), wire stringing, supervision, blasting, and construction inspection. The distribution of local/non-local workers shown in Figure 3.13-4 assumes that non-local workers would account for 74 percent of the total workforce for the duration of the Project. Local employment by month for each 140-mile segment is expected to range from 14 workers per month in month 24 to 75 workers per month in months 4, 5, and 6, with an average monthly employment of 54.

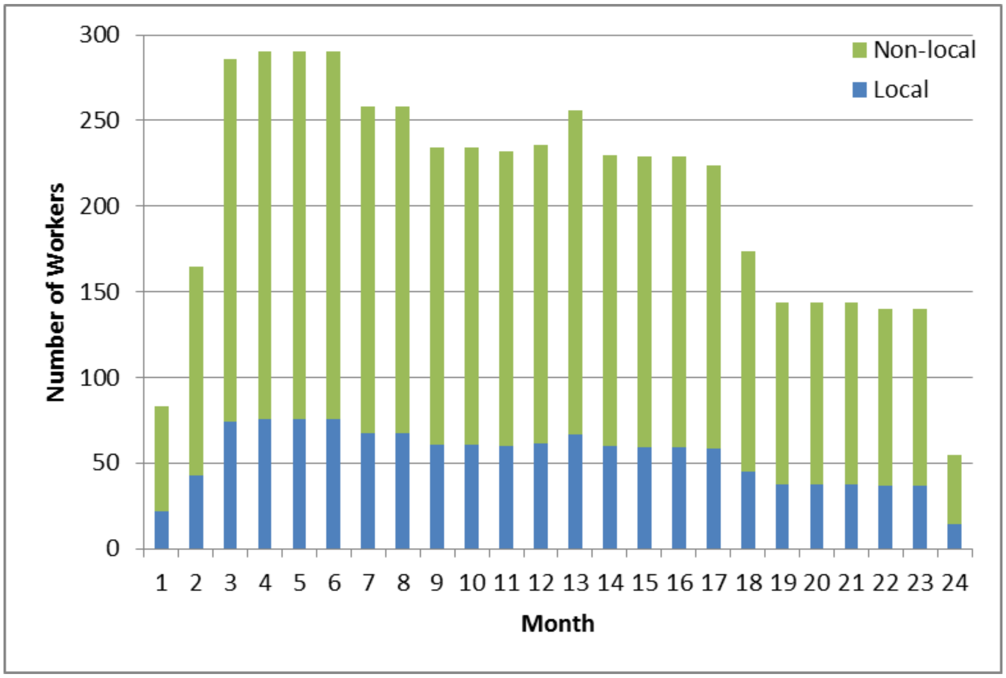

Figure 3.13-4: Estimated Construction Workforce per 140-mile Segment of HVDC Transmission Line by Month and Local/Non-Local Workers

Source: Clean Line (2013)

Non-local employment is expected to range from 41 workers per month in month 24 to 215 workers per month in months 4 to 6, with an average monthly employment of 153 (Figure 3.13-4). Very few, if any, of the non-local workers employed during the construction phase of each segment would be expected to permanently relocate to the affected areas. For the purposes of analysis, 10 percent of non-local workers temporarily relocating to the Project sites are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be three, two adults and one school-age child (Clean Line 2013).

Table 3.13-23 compares the projected average and peak numbers of people relocating by region with the corresponding 2012 population totals. Estimates of people by region are based on the estimated workforce per 140-mile segment, adjusted to account for the miles of HVDC transmission line that would be located in each region. Projected temporary peak increases in population range from less than 0.1 percent of total existing (2012) population in Region 7 to 0.4 percent in Region 1.

Table 3.13-23:
Projected Temporary Change in Population During Construction of the Applicant Proposed Route by Region

Region	2012 Population[1]	Average Employment Forecast		Peak Employment Forecast	
		Number of People Temporarily Relocating[2]	Percent of 2012 Population	Number of People Temporarily Relocating[2]	Percent of 2012 Population
1	51,652	143	0.3%	201	0.4%
2	88,067	135	0.2%	189	0.2%
3	348,517	218	0.1%	306	0.1%
4	147,279	156	0.1%	218	0.1%
5	334,750	171	0.1%	239	0.1%
6	42,397	56	0.1%	79	0.2%
7	1,042,441	39	0.0%	55	0.0%

1 Existing population data are estimates prepared by the USCB (2014a). These estimates are presented by county in Table 3.13-4.

2 The estimated numbers of people temporarily relocating are based on the projected workforce requirements shown in Figure 3.13-4. An estimated 10 percent of workers temporarily relocating are assumed to be accompanied by their families; the average size of a family that is relocating is assumed to be three, two adults and one school-age child. Workers and their families are allocated by region based on the total miles of transmission line proposed for each region.

Construction of the HVDC transmission line, converters stations, and AC collection system routes could potentially occur at the same time, with associated temporary population increases also taking place at the same time. If this were to occur, the largest overall temporary population increases would occur in Region 1, with the concurrent construction of the HVDC transmission line, Oklahoma converter station, and four to six AC transmission lines. The combined peak increase in population in Region 1 would be equivalent to 1.5 percent of the 2012 population total. In Region 7, the combined peak (HVDC transmission line plus the Tennessee converter station) would be equivalent to 0.03 percent of the 2012 population (Table 3.13-24).

Table 3.13-24:
Projected Temporary Change in Population During Construction of the Applicant Proposed Route, Converter Stations, and AC Collection System Routes by Region

Region[1]	2012 Population	Average Employment Forecast[1]		Peak Employment Forecast[1]	
		Number of People Temporarily Relocating	Percent of 2012 Population	Number of People Temporarily Relocating	Percent of 2012 Population
1	51,652	526	1.0%	779	1.5%
7	1,042,441	161	0.0%	268	0.0%

1 Average and peak employment forecasts by region include the following Project components:
Region 1: 115.5 miles of HVDC transmission line, the Oklahoma converter station, and six AC collection system routes with an average length of 34.4 miles (total length 206 miles)
Region 7: 42.8 miles HVDC transmission line and the Tennessee converter station

3.13.6.2.1.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma, including 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 3). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). These workers would be responsible for operations and maintenance of all of the HVDC and AC transmission lines, including those located in Regions 4, 5, and 7. These estimated staffing levels would have no noticeable impact on existing population levels in the potentially affected counties or regions.

Operations and maintenance of the Oklahoma converter station would employ up to 15 workers. If these workers and those required to operate and maintain the HVDC and AC transmission lines in Texas County all permanently relocated to the area from elsewhere, these combined staffing levels (30 workers) would not be expected to have a noticeable impact on existing population levels. Assuming an average family size of three people, a permanent increase in population of 90 people, about 0.4 percent of the estimated 2012 total of 20,620 would result (Table 3.13-4). The operations and maintenance employees associated with the Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.1.3.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.2 Economic Conditions

3.13.6.2.2.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.2.1.1 Construction Impacts

Construction of the Oklahoma and Tennessee converter stations would each result in a temporary increase in employment and income in the surrounding area. Construction of each converter station is expected to cost approximately $250 million and employ an average of 138 workers over a 32-month construction period, resulting in estimated total employee earnings of $16.2 million.

Viewed in terms of annualized jobs, each converter station would provide approximately 367 years of employment, with 143 of these job-years in the first 12 months (Year 1), 188 job-years in Year 2, and 36 job-years in Year 3 (Table 3.13-25). Annualized jobs are employment estimates adjusted to be based on 12 months of employment. These estimates do not directly translate into numbers of individual workers, who may be employed for shorter periods. Construction of the Oklahoma converter station would support an estimated total (direct, indirect, and induced) of 266 jobs in Year 1, 348 jobs in Year 2, and 67 jobs in Year 3 (Table 3.13-25). Construction of the Project would also support an estimated total (direct, indirect, and induced) earnings of about $11.3 million in Year 1, $14.8 million in Year 2, and $2.8 million in Year 3 (Table 3.13-26).

Construction of the Tennessee converter station would support an estimated total (direct, indirect, and induced) of 285 jobs in Year 1, 373 jobs in Year 2, and 72 jobs in Year 3 (Table 3.13-25). Construction of the Project would also support an estimated total (direct, indirect, and induced) earnings of about $12.2 million in Year 1, $16.0 million in Year 2, and $3.1 million in Year 3 (Table 3.13-26).

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Table 3.13-25:
Estimated Total Employment Associated with Construction of the Converter Stations, AC Collection System Routes, and Applicant Proposed Route by Region and Year

Region	Year 1			Year 2			Year 3		
	Direct Employment	Indirect and Induced Employment[1]	Total Employment[2]	Direct Employment	Indirect and Induced Employment[1]	Total Employment[2]	Direct Employment	Indirect and Induced Employment[1]	Total Employment[2]
Converter Stations[3 4]									
1	143	123	266	188	160	348	36	31	67
7	143	142	285	188	185	373	36	36	72
AC Collection System[5]									
1	305	284	589	305	284	589			
Applicant Proposed Route[6]									
1	186	159	345	137	117	254			
2	175	149	324	129	110	239			
3	283	241	524	209	178	387			
4	202	172	374	149	127	276			
5	221	189	410	163	140	303			
6	73	62	136	54	46	100			
7	50	46	97	37	32	69			
Converter Stations, AC Collection System, and Applicant Proposed Route[7]									
1	634	565	1,199	630	561	1,191	36	31	67
7	194	188	382	225	217	442	36	36	72

1 Indirect and induced effects are estimated using the applicable state multipliers for the construction sector. Regions 4 and 7 include counties from more than one state (see Table 3.13-1). For these regions, the projected construction workforce is divided by state with the appropriate state multipliers used to estimate indirect and induced effects.
2 Total employment consists of direct, indirect, and induced employment.
3 Construction of each converter station is expected to take place over a 32-month period (Figure 3.13-2).
4 The Oklahoma converter station would be located in Region 1; the Tennessee converter station would be located in Region 7.
5 The AC collection system routes assume that six routes with an average length of 34.4 miles would be built. Construction of all six average routes would take place over a 24-month construction period with the workforce assumed to be divided equally between Year 1 and Year 2 for the purposes of analysis.
6 The Applicant Proposed Route would be constructed in five 140-mile-long segments, each taking 24 months to complete. These segments are assumed to be constructed concurrently for the purposes of analysis.
7 Data are presented for those regions with two or more Project components only. Region 1 includes the proposed Oklahoma converter station, approximately 206 miles of AC collection system routes, and 115.5 miles of HVDC transmission line. Region 7 includes the proposed Tennessee converter station and approximately 42.8 miles of HVDC transmission line.

Table 3.13-26:
Estimated Total Earnings Associated with Construction of the Converter Stations, AC Collection System Routes, and Applicant Proposed Route by Region and Year ($ million)

Region	Year 1			Year 2			Year 3		
	Direct Earnings[1]	Indirect and Induced Earnings[1 2]	Total Earnings[1 3]	Direct Earnings[1]	Indirect and Induced Earnings[1 2]	Total Earnings[1 3]	Direct Earnings[1 2]	Indirect and Induced Earnings[1 2]	Total Earnings[1 3]
Converter Stations[4 5]									
1	$6.3	$5.0	$11.3	$8.3	$6.5	$14.8	$1.6	$1.3	$2.8
7	$6.3	$5.9	$12.2	$8.3	$7.7	$16.0	$1.6	$1.5	$3.1
AC Collection System[6]									
1	$13.4	$11.2	$24.6	$13.4	$11.2	$24.6			
Applicant Proposed Route[7]									
1	$8.2	$6.4	$14.6	$6.0	$4.8	$10.8			
2	$7.7	$6.1	$13.8	$5.7	$4.5	$10.2			
3	$12.5	$9.8	$22.3	$9.2	$7.2	$16.4			
4	$8.9	$6.3	$15.2	$6.6	$4.7	$11.2			
5	$9.7	$6.6	$16.3	$7.2	$4.9	$12.1			
6	$3.2	$2.2	$5.4	$2.4	$1.6	$4.0			
7	$2.2	$1.8	$4.0	$1.6	$1.3	$3.0			
Converter Stations, AC Collection System, and Applicant Proposed Route[8]									
1	$27.9	$22.6	$50.6	$27.8	$22.5	$50.2	$1.6	$1.3	$2.8
7	$8.5	$7.7	$16.2	$9.9	$9.0	$18.9	$1.6	$1.5	$3.1

1 Direct earnings estimates are based on an average annual construction salary of $44,050 (BLS 2012). Earnings estimates are presented in millions of dollars ($ million).

2 Indirect and induced effects are estimated using the applicable state multipliers for the construction sector. Regions 4 and 7 include counties from more than one state (see Table 3.13-1). Indirect and induced earnings are estimated based on the share of construction in each state.

3 Total earnings consist of direct, indirect, and induced earnings.

4 Construction of each converter station is expected to take place over a 32-month period (Figure 3.13-2).

5 The Oklahoma converter station would be located in Region 1; the Tennessee converter station would be located in Region 7.

6 The AC collection system routes assume that six routes with an average length of 34.4 miles would be built. Construction of all six average routes would take place over a 24-month construction period with the workforce assumed to be divided equally between Year 1 and Year 2 for the purposes of analysis.

7 The Applicant Proposed Route would be constructed in five 140-mile-long segments, each taking 24 months to complete. These segments are assumed to be constructed concurrently for the purposes of analysis.

8 Data are presented for those regions with two or more Project components only. Region 1 includes the proposed Oklahoma converter station, approximately 206 miles of AC collection system routes, and 115.5 miles of HVDC transmission line. Region 7 includes the proposed Tennessee converter station and approximately 42.8 miles of HVDC transmission line.

Total regional economic impacts are estimated at the state level using direct-effect multipliers for earnings and for employment from the U.S. Bureau of Economic Analysis' RIMS II regional modeling system (BEA 2013b). The multipliers for the construction sector in Tennessee are slightly higher than those for the corresponding sector in Oklahoma and, as a result, *total* estimates for the Tennessee converter station are higher than those for the Oklahoma converter station.

3.13.6.2.2.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to support up to 15 workers, with total estimated annual earnings of approximately $1 million. Operations and maintenance activities associated with the Oklahoma converter station would support an estimated total (direct, indirect, and induced) of 54 jobs and $2.1 million in annual earnings (Table 3.13-27). Statewide multipliers for the utilities sector are lower in Tennessee than in Oklahoma. The corresponding total annual impacts for the Tennessee converter station are estimated to be 39 jobs and $1.74 million in total annual earnings (Table 3.13-28).

Table 3.13-27:
Total Annual Economic Impacts from Operations and Maintenance of the Oklahoma Converter Station

Impacts	Employment (Jobs)	Annual Earnings ($ million)[1]
Direct Impact	15	$1.02
Indirect and Induced Impacts[2]	39	$1.11
Total Impact	54	$2.13

1 Total earnings were estimated based on the 2012 estimate of $67,950 for the annual average wage across the United States for all occupations in the electric power generation, transmission, and distribution industry (BLS 2012).

2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct-effect multipliers for the state of Oklahoma (BEA 2013b).

Table 3.13-28:
Total Annual Economic Impacts from Operations and Maintenance of the Tennessee Converter Station

Impacts	Employment (Jobs)	Annual Earnings ($ million)[1]
Direct Impact	15	$1.02
Indirect and Induced Impacts[2]	24	$0.72
Total Impact	39	$1.74

1 Total earnings were estimated based on the 2012 estimate of $67,950 for the annual average wage across the United States for all occupations in the electric power generation, transmission, and distribution industry (BLS 2012).

2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct-effect multipliers for the state of Tennessee (BEA 2013b).

3.13.6.2.2.1.3 Decommissioning Impacts

Decommissioning of the each converter station would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.2.2.2 AC Collection System

3.13.6.2.2.2.1 Construction Impacts

Estimates of direct employment and earnings are presented by alternative in Table 3.13-29. These estimates assume similar workforce requirements to those estimated for the HVDC transmission line, with direct earnings estimates based on an average annual construction worker salary of $44,050 (BLS 2012). Total (direct, indirect, and induced) employment and earnings are estimated using the applicable multipliers for Oklahoma and Texas. The resulting annual total employment estimates range from 43 for AC Collection System Route SW-1 to 154 for AC Collection System Route NW-2; respective total earnings are estimated to be $1.7 million and $6.5 million.

Table 3.13-29:
Total Economic Impacts from Construction by AC Collection System Route

Route[1]	Direct Employment	Indirect and Induced Employment[2]	Total Employment	Direct Earnings ($ million)	Indirect and Induced Earnings ($ million)	Total Earnings ($ million)
E-1	43	37	80	$1.9	$1.5	$3.4
E-2	59	50	109	$2.6	$2.0	$4.6
E-3	59	50	109	$2.6	$2.0	$4.6
NE-1	44	38	82	$2.0	$1.5	$3.5
NE-2	39	33	72	$1.7	$1.3	$3.0
NW-1	77	65	142	$3.4	$2.7	$6.1
NW-2	83	71	154	$3.6	$2.9	$6.5
SE-1	60	64	124	$2.6	$2.4	$5.0
SE-2	20	23	43	$0.9	$0.8	$1.7
SE-3	73	75	148	$3.2	$2.9	$6.1
SW-1	20	23	43	$0.9	$0.8	$1.7
SW-2	55	60	115	$2.4	$2.3	$4.7
W-1	31	26	57	$1.4	$1.1	$2.5
Average	51	47	98	$2.2	$1.9	$4.1

1 Construction is expected to take place over a 24-month period.
2 Indirect and induced impacts are estimated using the BEA RIMS II direct effect multipliers for the states of Oklahoma and Texas (BEA 2013b).

Assuming that six routes with an average length of 34.4 miles are constructed would result in direct annual employment of 305, with total (direct, indirect, and induced) employment of about 589 jobs (Table 3.13-25). Direct employment would support $13.4 million in employee earnings, with total employment supporting $24.6 million. These direct and total employment estimates are equivalent to approximately 0.9 percent and 1.7 percent of total employment in Region 1 (35,599) in 2011, respectively (Table 3.13-6).

3.13.6.2.2.2.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma, including 15 in Guymon, Oklahoma (Texas County) (Region 1). The potential economic impacts of this employment are discussed below in the Applicant Proposed Route section.

3.13.6.2.2.2.3 Decommissioning Impacts

Decommissioning of the AC transmission lines would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.2.2.3 HVDC Applicant Proposed Route

3.13.6.2.2.3.1 Construction Impacts

The transmission line would be constructed in five 140-mile-long segments, each taking 24 months to complete. The estimated workforce is shown by month for a representative 140-mile segment in Figures 3.13-3 and 3.13-4. Total employment by month is expected to range from 55 workers in month 24 to a peak of 290 workers in months 4, 5, and 6, with an average monthly employment of 207. Viewed in terms of annualized jobs, each 140-mile segment would provide approximately 414 years of employment, with approximately 58 percent or 238 of these job-years in the first 12 months (Year 1) and the remaining 176 job-years in Year 2.

Table 3.13-30 compares the projected number of job-years for each region with the corresponding 2011 employment totals. Projected job-years are presented by 12-month period (Year 1 and 2) based on the estimated workforce per 140-mile segment, adjusted to account for the miles of HVDC transmission line that would be located in each region. Viewed as a share of total employment in 2011, projected construction employment ranges from 0.01 percent in Region 7 (Years 1 and 2) to 0.5 percent in Region 1 (Year 1).

Table 3.13-30:
Estimated Direct Construction Employment for the Applicant Proposed Route by Region and Year

		Year 1		Year 2	
Region[1]	2011 Employment[2]	Direct Jobs	Percent of 2011 Employment	Direct Jobs	Percent of 2011 Employment
1	35,599	186	0.5%	137	0.4%
2	55,875	175	0.3%	129	0.2%
3	177,897	283	0.2%	209	0.1%
4	60,648	202	0.3%	149	0.2%
5	164,835	221	0.1%	163	0.1%
6	16,439	73	0.4%	54	0.3%
7	663,979	50	0.0%	37	0.0%

1 Estimated employment by region is based on the projected workforce requirements shown in Figure 3.13-4. Workers are allocated by region based on the total miles of transmission line proposed for each region.
2 Existing employment data are from the BEA (2013b) and presented by county in Table 3.13-6.

Total (direct, indirect, and induced) employment and earnings estimates for the construction phase of the Project are presented by region and year in Tables 3.13-25 and 3.13-26, respectively. These estimates were developed using an average annual construction worker salary of $44,050 and direct-effect multipliers for the corresponding states. Total employment divided into direct and indirect/induced components is shown graphically for Years 1 and 2 in Figures 3.13-5 and 3.13-6, respectively.

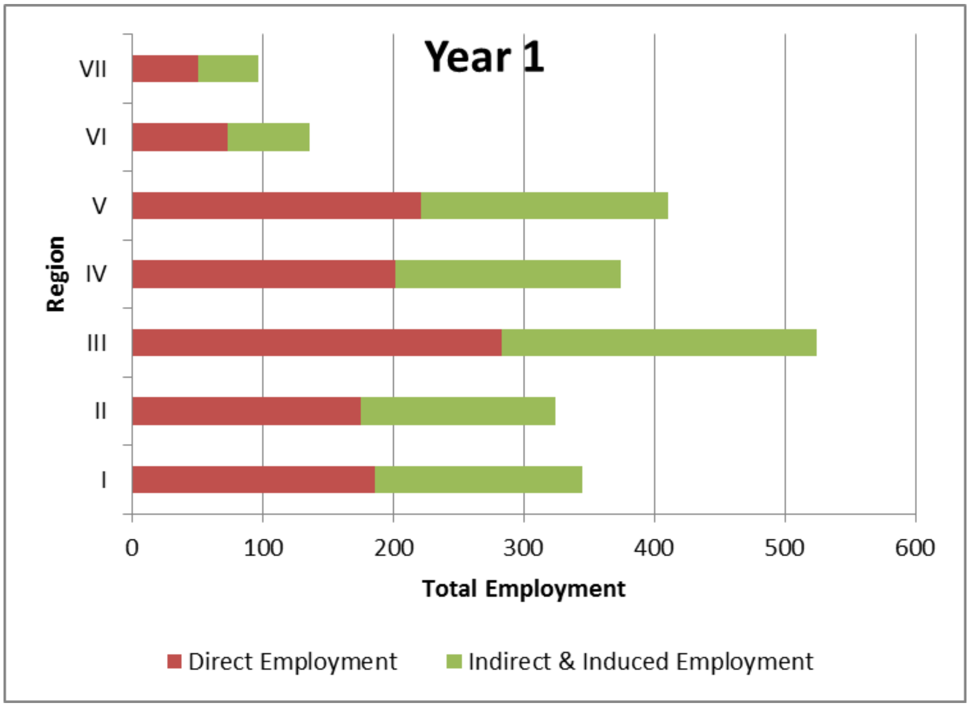

Figure 3.13-5: Total Projected HVDC Construction-Associated Employment by Region, Year 1

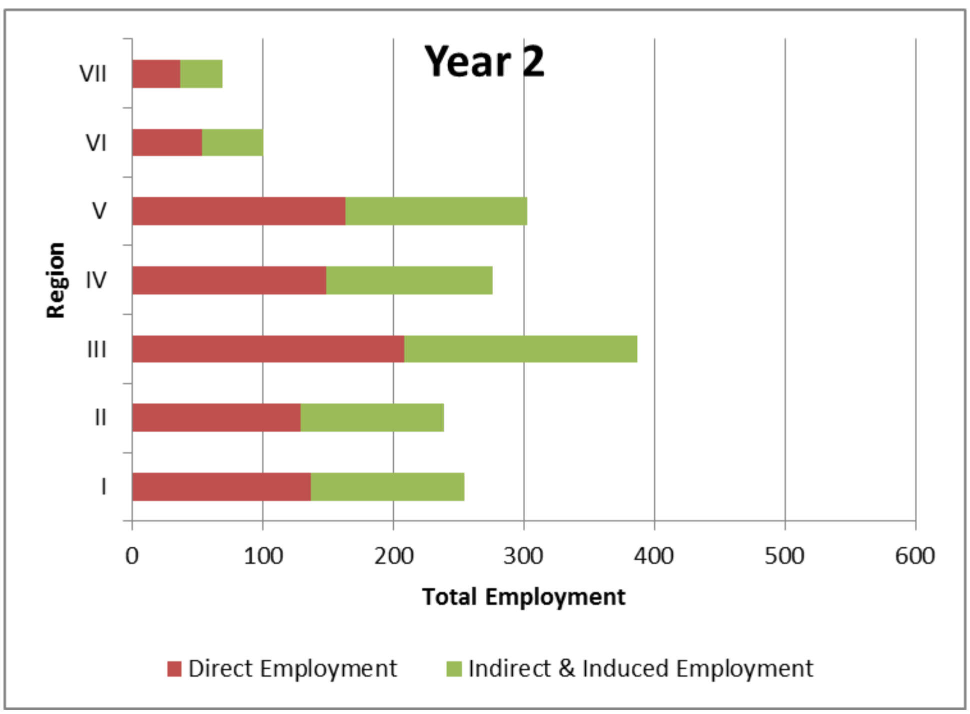

Figure 3.13-6: Total Projected HVDC Construction-Associated Employment by Region, Year 2

As noted above, an estimated 58 percent of the total construction employment (viewed in terms of job-years) would occur in Year 1 (as shown in Figures 3.13-3 and 3.13-4). Viewed by region, total employment in Year 1 would range from 97 jobs in Region 1 to 524 jobs in Region 3, reflecting the relative length of transmission line proposed for each region (Table 3.13-25). Viewed as a share of total employment in 2011, total projected construction employment in Year 1 would range from 0.01 percent of total employment in Region 7 to 1.0 percent in Region 1. Estimated direct earnings for construction activities in Year 1 would range from $2.2 million in Region 7 to $12.5 million in Region 3. Estimated total (direct, indirect, and induced) earnings in Year 1 range from about $4 million in Region 7 to $22.3 million in Region 3 (Table 3.13-26).

Table 3.13-25 also summarizes the direct and total (direct, indirect, and induced) employment that would be supported if construction of the converter stations, AC collection system routes, and Applicant Proposed Route were to occur at the same time. Data are presented by year and region. The largest combined employment totals would occur in Region 1, with the concurrent construction of about 116 miles of HVDC transmission line, the Oklahoma converter station, and an estimated 206 miles of AC collection system transmission line. The estimated miles for the AC collection system routes assume that six routes with an average length of 34.4 miles would be built. The combined estimated total employment in Region 1 would be 1,199 and 1,191 in Years 1 and 2, equivalent to about 3.3 percent of total employment in the region in 2011. Combined total employment in Region 7 would be approximately 382 jobs in Year 1 and 442 jobs in Year 2, equivalent to about 0.1 percent of total employment in the region in 2011 (Table 3.13-25).

Total combined employment in Region 1 would support an estimated $50.6 million and $50.2 million in earnings in Years 1 and 2, respectively (Table 3.13-26). In Region 7, combined converter station- and transmission line-related construction employment would support estimated total (direct, indirect, and induced) earnings of $16.2 million in Year 1 and $18.9 million in Year 2 (Table 3.13-26).

3.13.6.2.2.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma: 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 3). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). Using the annual average wage for installation, maintenance, and repair occupations in the electric power generation, transmission, and distribution industry ($67,950), these jobs would support an estimated direct total of $2.07 million in salary and wages in Oklahoma and $0.65 million in Arkansas. Total (direct, indirect, and induced) estimated employment and earnings are presented by affected region in Table 3.13-31.

Table 3.13-31:
Estimated Total Employment Associated with Operations and Maintenance of the Applicant Proposed Route by Region and Year

Region[1]	Employment		Earnings	
	Direct	Total (Direct, Indirect, and Induced)[2]	Direct[3] ($ million)	Total (Direct, Indirect, and Induced)[2] ($ million)
1	15	54	$1.0	$2.1
2	7	25	$0.5	$1.0
3	10	36	$0.7	$1.4
6	10	25	$0.7	$1.1

1 Data are presented for the regions where operations and maintenance staff would be based. No operations and maintenance staff are proposed for locations in Regions 4, 5, or 7.
2 Total impacts (employment and earnings) are estimated using statewide multipliers for the utilities sector for Oklahoma (Regions 1, 2, and 3) and Arkansas (6) from the BEA (2013b).
3 Total direct earnings are estimated using an annual average wage of $67,950 (BLS 2012)

Operations and maintenance of the Oklahoma converter station is expected to support up to 15 workers, with estimated annual earnings of approximately $1 million. This employment would support approximately 54 total (direct, indirect, and induced) jobs and $2.1 million in annual earnings (Table 3.13-27). Operations and maintenance of this converter station and HVDC and AC transmission line operations and maintenance in Region 1 would support a combined annual total of 108 jobs and $4.3 million in earnings. The operation and maintenance employees associated with the Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.2.3.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.2.3 Agriculture

3.13.6.2.3.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.3.1.1 Construction and Operations and Maintenance

Both of the converter stations would affect agricultural land use. The Oklahoma converter station is located on rangeland and would involve the conversion of 45 to 60 acres to industrial use. Construction of the Tennessee converter station would involve the conversion of approximately 45 to 60 acres of primarily agricultural land use to industrial land use. In both cases, an additional 5 to 10 acres would be temporarily disturbed during construction. Other related short- and long-term land use impacts are described in Section 3.2.6.2.1. Although the exact location of the Tennessee converter station has not yet been determined, potentially affected agricultural land uses would likely include cultivated crops and pasture/hay. These land use conversions would affect a very small share of the total agricultural land use in the Texas County, Oklahoma, Shelby, and Tipton counties, Tennessee, which included about 1.2 million, 92,299, and 170,182 acres in 2007, respectively (see Table 3.13-9). As noted above, the Tennessee converter station would either be located in Shelby or Tipton county.

3.13.6.2.3.1.2 Decommissioning Impacts

Decommissioning of the converter stations would involve restoring the affected sites to their preconstruction condition to the extent possible and a return to their preconstruction use. Some of the affected areas could be used for agriculture again at some point in the future.

3.13.6.2.3.2 AC Collection System and HVDC Applicant Proposed Route

3.13.6.2.3.2.1 Construction and Operations and Maintenance

The majority of the land in the ROI used to assess land use impacts is used for agriculture, with cultivated crops, grassland/herbaceous, and pasture/hay land covers together ranging from 38 percent of the land use ROI in Region 5 to 90 percent in Region 1 (see Tables 3.10-3 through 3.10-11). Livestock dominates the agricultural sectors in Regions 1 through 4 in terms of total market value of agricultural products sold (Table 3.13-9; Figure 3.13-1). Cultivated crops make up a large share of the land use in the land use ROI for Regions 6 and 7, accounting for 78 percent and 70 percent of their respective totals. Crops also account for the vast majority of the value of agricultural products sold in these regions (Table 3.13-9; Figure 3.13-1).

The introduction of a new transmission line can have an impact on agricultural production by reducing the acreage available for cultivation and, in some cases, disrupting existing harvest patterns, with new transmission line structures affecting the farmer's ability to maneuver equipment in the vicinity of the immediately affected area. A new transmission line also has the potential to negatively affect farm operations that employ pivot irrigation systems by potentially disrupting the "sweep area." Potential impacts to agricultural land are discussed in Section 3.2 and include the potential impacts to livestock grazing, crop production, irrigation, global navigation satellite systems (GNSS), and aerial spraying. Impacts addressed include those associated with construction, operations and maintenance, and decommissioning of the Project.

Viewed in terms of agricultural operations in the socioeconomic ROI, total estimated disturbance based on the land use ROI represents a very small share of the 14 million acres of land in farms in the 33 potentially affected counties and is unlikely to noticeably affect overall agricultural production and employment in any of the affected counties. Impacts could, however, be potentially significant to the individual operations affected.

3.13.6.2.3.2.1.1 *Livestock*

Construction and operations and maintenance of the transmission lines could affect the economic value of livestock production in the ROI by increasing ranchers' costs and decreasing available forage. Potential impacts during construction could result from road construction providing increased access and related disturbance to livestock grazing patterns, temporary reductions in available forage, and reductions in the palatability of forage due to construction-related dust.

The Project could affect net earnings from livestock production in the following ways:

- Decreased forage from land taken out of production.
- Increased management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment.
- Increased management costs associated with moving livestock around Project-related structures and easements.

Total construction- and operations and maintenance-related disturbance to rangeland and pasture is discussed by Region in Section 3.2. This analysis evaluates impacts in terms of acres of forage that would be temporarily (construction) or permanently (operations) unavailable for use.

The value of the grazing land that would be affected can be approximated using data compiled by the USDA. The average land value for pasture in the affected states ranged from $1,330 per acre in Oklahoma to $3,600 per acre in Tennessee (Table 3.13-32). Average cash rents for pasture ranged from $6.5 per acre in Texas to $20 per acre in Tennessee (Table 3.13-33).

Table 3.13-32:
Average Agricultural Land Value per acre by State, 2013

State	Pasture	Cropland		
		Irrigated[1]	Non-Irrigated[1]	Overall Average[1, 2]
Texas	1,560	1,830	1,610	1,640
Oklahoma	1,330	N/A	1,500	1,520
Arkansas	2,400	3,100	1,950	2,560
Tennessee	3,600	N/A	N/A	3,550
US Total	1,200	N/A	N/A	4,000

N/A = Not available; separate irrigated and non-irrigated values are only provided for states with significant irrigated acreage
1 Values are expressed in dollars per acre.
2 This represents the average land value per acre for all cropland (irrigated and non-irrigated).
Source: USDA (2013b)

Table 3.13-33:
Average Agricultural Cash Rent per Acre by State, 2013[1]

State	Pasture	Cropland		
		Irrigated[1]	Non-Irrigated[1]	Overall Average[1, 2]
Texas	6.5	82	24	35.5
Oklahoma	12	70	32	33.5
Arkansas	18	122	50	95.5
Tennessee	20	160	89	92
US Total	12	202	125	136

1 Values are expressed in dollars per acre.
2 This represents the average land value per acre for all cropland (irrigated and non-irrigated).
Source: USDA (2013a)

3.13.6.2.3.2.1.2 *Cropland*

Construction of the transmission lines could affect net earnings from cropland in the following ways:

- Reduce acreage available for cultivation and use due to the placement of transmission structures, access roads, and other proposed Project uses.
- Increase irrigation costs due to limitations placed with respect to pivot irrigation systems.
- Increase costs due to the need to maneuver farming equipment around transmission structures.
- Increase management costs associated with controlling additional noxious and invasive vegetation species introduced by Project construction equipment.

- Reduce productivity as a result of construction-related soil compaction and erosion and damage to drainage tiles.

Potential impacts to cropland would vary based on the design and location of the transmission line structures and access roads relative to existing agricultural operations.

The value of the cropland that would be affected can be approximated using average land value and cash rent data compiled by the USDA (2013a, 2013b). The average land value for cropland in the affected states ranged from $1,520 per acre in Oklahoma to $3,550 per acre in Tennessee (Table 3.13-32). Average land values for irrigated and non-irrigated cropland are only available for those states with substantial irrigated acreage. Values are typically higher for irrigated land as illustrated in Table 3.13-32. Average cash rents for cropland ranged from $33.5 per acre in Oklahoma to $95.5 per acre in Arkansas (Table 3.13-33). Average cash rents were higher for irrigated than non-irrigated cropland, with average cash rents for irrigated cropland ranging from $70 per acre in Oklahoma to $160 per acre in Tennessee.

The Arkansas Delta Agricultural Economic Impact Study (Arkansas Delta study) commissioned by the Applicant assesses the potential economic impact of the Project on agricultural resources in Jackson, Poinsett, Cross, and Mississippi counties, Arkansas (see Appendix J). These counties are spread over two regions, Regions 6 and 7 (Table 3.13-1). Much of the cropland in these counties has a higher land value than the Arkansas average of $2,560 per acre in 2013 (Table 3.13-32), with prices ranging up to $5,000 per acre. These high values reflect local conditions (soil and topography) that allow farmers to precision level their fields and the ready availability of irrigation water from shallow aquifers.

The Arkansas Delta study estimated the following potential Project-related monetary impacts: one-time impacts expected to occur during construction and operation and annual impacts expected to occur for the life of the project.

3.13.6.2.3.2.1.2.1 One-Time Impacts

Using a “with and without Project” framework, the Arkansas Delta study estimated one-time impacts to agricultural production using data from the University of Arkansas crop budgets and a weighted average of net returns for six crops (corn, soybeans, rice, cotton, wheat, and sorghum). Net returns are estimated by subtracting production and capital costs from gross revenues (average yield per crop × price per unit). Values for the six major crops were weighted based on their share of total cropland in the four study-area counties resulting in a “without Project” average net return of $331 per acre based on a full year of costs and returns (Table 3.13-34).

Net returns estimated for the same average or “composite” acre “with Project” assume no revenues and vary depending on the time year that Project construction begins and the production costs that have been incurred up to that point. If construction begins in March, estimated cumulative production costs per disturbed composite acre would be $60, increasing as the season progresses and peaking at $407 per acre in August. Capital recovery costs are assumed to be constant at $47 per composite acre. Table 3.13-34 shows estimated with Project net returns per composite acre by month.

Table 3.13-34:
Estimated Monetary Impact per Composite Acre by Month

Month	Value per Composite Acre[1]					
	Net Return Without Project	Gross Revenues With Project	Cumulative Production Cost With Project[2]	Capital Cost With Project	Net Return With Project[3]	Estimated Monetary Impact[4]
March	$331	$0	$60	$47	-$107	-$438
April	$331	$0	$161	$47	-$208	-$539
May	$331	$0	$289	$47	-$336	-$667
June	$331	$0	$344	$47	-$391	-$722
July	$331	$0	$369	$47	-$416	-$747
August	$331	$0	$407	$47	-$454	-$785
September	$331	$0	$264	$47	-$311	-$642

1 Values for an average or composite acre were estimated using data from University of Arkansas crop budgets, with values for six major crops (corn, soybeans, rice, cotton, wheat, and sorghum) weighted based on their share of total cropland in the four study area counties. Corresponding estimates of net returns are presented by crop in Appendix 7.7 to the Arkansas Delta study (see Appendix J to this EIS).

2 Production costs consist of operating and post-harvest costs. Operating costs were estimated based on seasonal investments in crop production, which increase as the season progresses up until harvest. For summer crops, production expenditures are lowest from October through February when investments mainly consist of field work completed in fall in preparation for the next crop. Field expenses start to increase in March as farmers till, fertilize, and implement weed control measures in advance of planting, and they continue to increase until the crop is harvested in the fall.

3 The net return with Project equals gross revenues with Project minus cumulative production and capital costs.

4 Estimated monetary impacts per composite acre consist of the net return with Project minus the net return without Project.

Source: Appendix J

3.13.6.2.3.2.1.2.2 Annual Impacts

The Arkansas Delta study (Appendix J of this EIS) considered potential annual impacts to agricultural water management systems, aerial application (crop dusting), crop production logistics, and crop insurance and commodity programs.

<u>Agricultural Water Management Systems</u>

According to Arkansas Delta study, the proposed transmission line structures could potentially affect both center-pivot and furrow irrigation systems. Where sprinkler (center-pivot) irrigation is used, depending on its location, the presence of a new transmission line structure could prevent the pivot from being able to traverse the entire circle, with the area affected increasing the closer the structure is located to the pivot point. For fields with furrow irrigation systems, placement of a new transmission line structure could block the flow of water downstream of the structure, with the area affected increasing the closer the structure is to the upper end of the furrow.

The Arkansas Delta study estimated potential monetary impacts based on the net return for a composite acre that is a weighted average of net returns for irrigated corn, soybean, cotton, and sorghum. Impacts may be estimated by assuming that land that is no longer irrigated will be converted to dryland production, with a commensurate reduction in yield per acre and net returns. The estimated change in net return would involve a reduction from $276 per composite acre to $104 per acre, a 62 percent reduction in net returns. Annual impacts may subsequently be estimated by adjusting estimated net returns based on the number of acres expected to be converted from irrigated to dryland farming.

Aerial Applications (Aerial Spraying)

The Arkansas Delta study assumes that the presence of a transmission line would impede the ability of applicators to apply fertilizers and chemicals resulting in a reduction in yields, which the study authors assumed would be equivalent to 50 percent of the without Project yield. Reducing yields by 50 percent would reduce net returns per composite acre from $331 to -$19 per acre. Impacts may subsequently be estimated by adjusted based on the number of acres where aerial application would be affected.

Crop Production Logistics

The placement of transmission line structures could potentially affect crop production logistics by requiring a farmer to spend additional time maneuvering around the structures. The Arkansas Delta study did not quantify these potential impacts, but it should be noted that with large equipment, the additional time required to maneuver could add to crop production costs in affected areas, especially when combined with associated damage to crops.

Crop Insurance and Commodity Programs

The Arkansas Delta study discusses potential impacts to crop insurance and commodity payment programs in qualitative terms. The crop insurance program uses a 10-year crop yield history to determine losses and payments. Any potential reduction in yield, therefore, has the potential to affect crop insurance damage assessments and payments should a crop be damaged from a storm. Further, changes in yield over time could potentially affect payments a farmer might receive from the new Agricultural Risk Coverage (Individual option) program in the 2014 Farm Bill.

3.13.6.2.3.2.2 Decommissioning Impacts

Potential impacts to agriculture during decommissioning would be similar to those experienced during construction. Decommissioning could involve restoring the affected sites to their preconstruction condition to the extent possible and a return to their preconstruction use. Some of the affected areas could be used for agriculture again at some point in the future.

3.13.6.2.4 Housing

An estimated 26 percent of the construction workforce would be hired and/or contracted locally (i.e., within commuting distance) and would likely commute to and from their homes to work each day. The remaining 74 percent of the construction workforce is assumed to permanently reside further than commuting distance from the Project sites and would be expected to temporarily relocate to the ROI or immediate vicinity for the duration of their employment, possibly commuting home on weekends, depending on the location of their primary residence (Clean Line 2014a). Approximately 10 percent of workers temporarily relocating are assumed for the purposes of analysis to be accompanied by their families (see Section 3.13.9.3).

Almost half (45 percent) of the workers temporarily relocating are expected to require motel or hotel rooms, with the remaining non-local workers expected to require rental housing (apartments, houses, or mobile homes) (20 percent), or provide their own housing in the form of RVs or pop-up trailers (35 percent). Construction workers, particularly those working in less populated areas, often commute relatively long distances to job sites depending on cost and availability of housing and community amenities/services within the vicinity. The Applicant estimates that workers could commute up to 2 hours or approximately 100 miles each way.

Housing availability within the vicinity of the Project would be influenced by a number of factors outside Project demand. Other sources of temporary housing demand could include other construction projects, community-sponsored events, and hunting and other recreational activities.

3.13.6.2.4.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.4.1.1 Construction Impacts

Construction of each of the converter stations is expected to employ an average of 138 workers over a 32-month construction period. The share of non-local workers is assumed to be 74 percent for the full duration of construction for each converter station, resulting in an average of 102 non-local workers employed over the 32-month construction period, with an estimated peak of 179 non-local workers employed during months 12 to 17 (Figure 3.13-2). The Oklahoma converter station would be located in Region 1; the Tennessee converter station would be located in Region 7.

Table 3.13-35 compares projected peak housing demand with estimated supply in the two affected regions. These data suggest that adequate temporary housing resources likely exist within each of the affected regions, a situation that is especially likely to be the case for the Tennessee converter station, which is located within commuting distance of the city of Memphis. Existing housing resources are substantially more limited in Region 1, within the counties that make up the region and also elsewhere within a commuting distance of up to 2 hours. Unlike Regions 3 through 7, there are no large communities within 2 hours commuting distance of Region 1. Economic development organizations in the Oklahoma Panhandle region have identified a potential shortage in permanent housing in and around the city of Guymon in Texas County, with these problems expected to be further exacerbated by future wind energy development (Fleming 2013).

3.13.6.2.4.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to employ up to 15 workers. These estimated staffing levels would have a minor impact on existing demand for housing in the potentially affected areas.

3.13.6.2.4.1.3 Decommissioning Impacts

Decommissioning each of the converter stations would require a labor force approximately equal to that needed for its construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.4.2 AC Collection System

3.13.6.2.4.2.1 Construction Impacts

Assuming six routes with an average length of 34.4 miles are constructed at the same time would result in a combined average of 226 non-local workers and an estimated combined peak of 316 non-local workers temporarily relocating to Region 1. A comparison of expected peak housing demand with existing temporary housing resources suggests that this demand would be equivalent to 52 percent of the hotel and motel rooms assumed to be available and 47 percent of all identified RV spaces (Table 3.13-35).

3.13.6.2.4.2.2 Operations and Maintenance Impacts

Combined operation of the HVDC and AC transmission lines in Region 1 is expected to employ 15 workers based in Guymon, Oklahoma (Texas County). This number is not expected to vary based on the selected AC collection system routes or affect existing trends in housing demand in Texas County.

Table 3.13-35:
Estimated Construction-Related Housing Demand by Project Component, Housing Type, and Region

Region	Projected Non-Local Employment[1]		Projected Peak Housing Demand[2]			Estimated Available Housing Units[3]			Projected Demand as a Share of Existing Resources		
	Average Employment (Jobs/Week)	Peak Employment (Jobs/Week)	Rental Housing	Hotel and Motel Rooms	RV Spaces	Rental Housing[4]	Hotel and Motel Rooms[5]	RV Spaces	Rental Housing	Hotel and Motel Rooms	RV Spaces
Converter Stations											
1	102	179	36	81	63	370	273	235	10%	29%	27%
7	102	179	36	81	63	23,358	2,957	393	0%	3%	16%
AC Collection System[6]											
1	226	316	63	142	111	370	273	235	17%	52%	47%
Applicant Proposed Route											
1	119	168	34	76	59	370	273	235	9%	28%	25%
2	112	158	32	71	55	862	401	94	4%	18%	59%
3	182	255	51	115	89	3,193	718	679	2%	16%	13%
4	130	182	36	82	64	1,335	467	440	3%	18%	14%
5	142	200	40	90	70	4,207	1,137	633	1%	8%	11%
6	47	66	13	30	23	908	60	51	1%	50%	45%
7	32	46	9	20	16	23,358	2,957	393	0%	1%	4%
Converter Stations, AC Collection System Routes, and Applicant Proposed Route											
1	447	663	133	298	232	370	273	235	36%	109%	99%
7	134	225	45	101	79	23,358	2,957	393	0%	3%	20%

1 An estimated 74 percent of the total construction workforce is assumed to be non-local for the duration of the Project.

2 Projected housing demand is assumed to be divided as follows: rental housing (apartments, houses, or mobile homes) (20 percent), hotel and motel rooms (45 percent), and RV spaces (35 percent) (Clean Line 2013).

3 Estimated available housing units are presented by county in Table 3.13-10. Data are presented for those counties within the ROI only.

4 Many of these available units include more than one bedroom and, if rented, could be occupied by more than one worker. A large number of in-migrating workers on similar projects typically rent a room in a house or live five in a rented house (BLM 2013).

5 Assumes an average occupancy rate of 75 percent for the purposes of analysis, with 25 percent of total units assumed to be potentially available.

6 Assumes six AC collection system routes with an average length of 34.4 miles.

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3.13.6.2.4.2.3 Decommissioning Impacts

Decommissioning of the AC transmission lines would require a labor force approximately equal to that needed during construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.4.3 HVDC Applicant Proposed Route

3.13.6.2.4.3.1 Construction Impacts

The HVDC transmission line would be constructed in five 140-mile-long segments, each taking 24 months to complete. Total employment by month is expected to range from 55 workers in month 24 to a peak of 290 workers in months 4, 5, and 6, with an average monthly employment of 207. The share of non-local workers is assumed to be 74 percent for the full duration of the Project. Non-local employment is expected to range from 41 workers per month in month 24 to 215 workers per month in months 4 to 6, with an average monthly employment of 153 (Figure 3.13-4).

Projected peak housing demand is compared with estimated supply by region in Table 3.13-35. The distribution of non-local workers is based on the miles of transmission line for each region and an average 140-mile-long segment. Demand for rental housing would range from less than 0.1 percent of the estimated available units in Region 7 to 9 percent in Region 1. Estimated peak demand for hotel and motel rooms as a share of existing available units would range from 1 percent in Region 7 to 50 percent in Region 6. Demand as a share of available hotel and motel rooms would also be relatively high in Region 1, accounting for about 28 percent of the available supply (Table 3.13-35).

Estimated peak demand for RV spaces as a share of total identified spaces would range from 4 percent in Region 7 to 59 percent in Region 2. Demand as a share of identified spaces would also be relatively high in Region 6, accounting for about 45 percent of the identified spaces (Table 3.13-35).

Table 3.13-35 also summarizes the estimated demand for housing if construction of the converter stations, AC collection system routes, and Applicant Proposed Route were to all peak at the same time. If construction of the Oklahoma converter station, six AC collection system routes, and the portion of the HVDC transmission line for Region 1 all occurred at the same time, demand for hotel and motel rooms would exceed the estimated available supply by 7 percent and demand for RV spaces would almost be equal to the total number of identified spaces (Table 3.13-35).

If the Tennessee converter station and the portion of the HVDC transmission line for Region 7 were built at the same time, demand for rental housing would be less than 1 percent of the estimated available properties, demand for hotel and motel rooms would be equivalent to 3 percent of the available supply, and demand for RV spaces would be equal to 20 percent of the total identified spaces (Table 3.13-35).

3.13.6.2.4.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma: 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 2). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). These estimated staffing levels would not be expected to affect existing trends in housing demand in the potentially affected counties or regions.

Operations and maintenance of the converter station in Texas County, Oklahoma, would employ up to 15 workers. If these workers and those required to operate and maintain the HVDC and AC transmission lines in Texas County all permanently relocated to the area from elsewhere, these combined staffing levels would still not be expected to have more than a minor impact on existing housing demand. The operations and maintenance employees associated with Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.4.3.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.5 Property Values

The HVDC transmission line would require a new ROW. The effect that a transmission line may have on property value is a damage-related issue that would be negotiated between the Applicant and the affected landowner during the easement acquisition process. In theory, the value of each easement should be equal to the difference in value of the affected property before and after easement acquisition and construction of the facilities.

Changes in land use often raise concerns about the potential effect these changes may have on nearby property values. Research into the relationship between electric transmission facilities and local property values has tended to focus on residential properties, employing research methods that can, for the most part, be divided into surveys and opinion-based studies on one hand and quantitative studies largely based on comparisons of market data on the other.

Research conducted since the 1980s has tended to support the idea that proximity to transmission lines may affect the desirability and, therefore, the value of residential property (Bottemiller et al. 2000; Colwell 1990; Cowger et al. 1996; Delaney and Timmons 1992; Des Rosiers 2002; Hamilton and Schwann 1995). Some observers linked this general finding to increased concerns regarding potential EMF-related health effects, but a nationwide survey of real estate appraisers suggests that, for the most part, potential negative effects on property values tend to be related to the visual impact of transmission line facilities (Delaney and Timmons 1992).

The results of the studies cited above suggest that proximity to electric transmission lines can have negative effects on residential property values, with average impacts ranging from less than 1 percent to about 10 percent. The findings of these studies also suggest that this impact decreases with distance and tends to decline over time. A detailed literature review conducted by Chalmers and Voorvaart (2009) supported these conclusions, finding that in studies where depreciation was found, the typical change ranged from 3 percent to 6 percent within a few hundred feet and tended to decrease with distance and over time.

Studies of property-value impacts during periods of physical change, such as new transmission line construction or structural rebuilds, have generally revealed greater short-term impacts than long-term effects. Most studies have concluded that other factors, such as the general location, the size of property, improvements, conditions, amenities, and supply and demand factors in a specific market area are more important criteria than the presence or absence of transmission lines in determining the value of residential real estate.

Some short-term adverse impacts on residential property values (and marketability) might occur on an individual basis as a result of the Project. However, these impacts would be highly variable, individualized, and are difficult to predict. Unique Project characteristics that need to be taken into consideration when assessing the potential effects of transmission line structures on residential property values include the type and height of the structures, the distance and view from the potentially affected property, intervening topography and vegetation, and the property market and type of landscape involved.

Few studies have addressed the impacts of transmission lines on the value of commercial and industrial properties. Those that have done so generally find the impacts are less than the impacts on residential properties. In interviews with appraisers, real-estate brokers, and owners and managers of commercial and industrial parks, Chapman (2005) found that, for the most part, the presence of a transmission line had little effect on market prices for commercial and industrial properties.

A review of studies of the impacts on agricultural land found that overhead transmission lines have the potential to reduce the sales price and the effect can vary widely, ranging from no effect to a decrease of 20 percent or more depending on the productivity of the land and the amount of disruption to farm operations (Kroll and Priestly 1992). More recently, Jackson (2010) assessed the impact of transmission lines on rural land used for agricultural or recreational purposes in Wisconsin. Using multivariate statistical analysis, Jackson found that prices for properties sold with a transmission line easement were 1.1 percent to 2.4 percent less than otherwise comparable properties sold at least 0.25 mile from a transmission line. These differences were not statistically significant (Jackson 2010).

3.13.6.2.6 Community Services

3.13.6.2.6.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.6.1.1 Construction Impacts

Projected peak employment and the number of workers and family members expected to temporarily relocate during construction of the converter stations is discussed in Section 3.13.9.3. The peak increase for each station, estimated to be about 213 people during months 12 to 17, would be equivalent to approximately 1 percent, 0.3 percent, and less than 0.1 percent of the respective existing (2012) populations in Texas County, Oklahoma, Tipton, and Shelby counties, Tennessee. The temporary addition of these workers to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel. The number of law enforcement and fire departments per county are identified in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the affected areas would be short term. It is anticipated that community commercial and retail services would experience an economic benefit from additional spending from relocating workers and their families.

The closest major medical facility to the Oklahoma converter station is the Memorial Hospital of Texas County, located 10.3 miles northwest of the site in Guymon, Oklahoma. This 47-certified-bed facility has a staff that includes 17 licensed practical nurses, 45 registered practical nurses, and two full-time physicians. This hospital provides emergency room services and would be capable of treating most construction-related injuries. At least six hospitals serve the Memphis area in Tennessee and would be capable of treating construction-related injuries were they to occur (Table 3.3-12). The temporary relocation of workers and family members to the affected areas is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

An average and peak of 10 and 18 school-age children are expected to temporarily relocate to the affected counties during construction of each converter station. This potential increase in the number of students would not be expected to affect existing average student/teacher ratios in either affected area (Table 3.13-13).

3.13.6.2.6.1.2 Operations and Maintenance Impacts

Operations and maintenance of each of the converter stations is expected to employ up to 15 workers. If these workers and their families were to relocate from elsewhere, the resulting very small increase in population would not be expected to noticeably affect the provision of community services.

3.13.6.2.6.1.3 Decommissioning Impacts

Decommissioning of each converter stations would require a labor force approximately equal to that needed for its construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.6.2 AC Collection System

3.13.6.2.6.2.1 Construction Impacts

Projected peak employment and the number of workers and family members expected to temporarily relocate during construction of the AC collection system routes are discussed in Section 3.13.9.3. Assuming that six routes with an average length of 34.4 miles are constructed would result in average and peak population increases of about 271 and 379 people, respectively, approximately 0.5 percent and 0.7 percent of the total 2012 population in Region 1. The temporary addition of these workers to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel. The number of law enforcement and fire departments per county are identified in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the area would be short term. It is anticipated that community commercial and retail services would experience an economic benefit from additional spending from relocating workers and their families.

Construction of the AC collection system routes could result in increased demand for emergency services. Local police assistance would likely be required to facilitate traffic flows during construction at some road crossings and permits may be required for vehicle load and width limits for some of the vehicles delivering Project materials and supplies.

Medical facilities located in Region 1 are identified in Table 3.3-12. Medical facilities are limited in the Texas counties in the region. The Ochiltree General Hospital, a Level IV trauma center, provides emergency services in Ochiltree County. Emergency medical services are provided in Sherman County by the Stratford EMS. Additional hospitals are located in neighboring counties, including the Moore County Hospital, south of Sherman County, which provides 24-hour emergency services. The Oklahoma counties in Region 1—Cimarron, Texas, Beaver, and Harper counties—each have a hospital that provides 24-hour emergency services. These facilities would be capable of treating most construction-related injuries. The temporary relocation of workers and family members to the counties in the region is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

The estimated number of children expected to temporarily relocate to Region 1 during peak construction ranges from about 2 (AC Collection System Routes SE-2 and SW-1) to 8 (AC Collection System Route Alternative NW-1). If six routes with an average length of 34.4 miles are constructed, an estimated peak increase of 38 school-age children would result. These children would likely be located in a number of different school districts throughout Region 1 and would not be expected to affect existing average student/teacher ratios (Table 3.13-13).

3.13.6.2.6.2.2 Operations and Maintenance Impacts

Combined operation of the HVDC and AC transmission lines in Region 1 is expected to employ 15 workers based in Guymon, Oklahoma (Texas County). This number is not expected to vary based on the selected AC collection system routes. If these workers and their families were to relocate from elsewhere, the resulting very small increase in population would not be expected to noticeably affect the provision of community services.

3.13.6.2.6.2.3 Decommissioning Impacts

Decommissioning of the transmission lines would require a labor force approximately equal to that needed for their construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.6.3 HVDC Applicant Proposed Route

3.13.6.2.6.3.1 Construction Impacts

Projected peak employment and the number of workers and family members expected to temporarily relocate during construction of the Applicant Proposed Route are identified by Region in Table 3.13-23, with peak increases in populations ranging from less than 0.1 percent (Region 7) to 0.4 percent (Region 1) of 2012 population totals. The temporary addition of these workers to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel. Law enforcement and fire departments within each region are identified by county in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the affected Regions would be short term. It is anticipated community commercial and retail services would experience an economic benefit from additional spending from relocating workers and their families.

Construction of the HVDC transmission line could result in increased demand for emergency services. Local police assistance would likely be required to facilitate traffic flows during construction at some road crossings and permits may be required for vehicle load and width limits for some of the vehicles delivering Project materials and supplies.

Medical facilities located near the transmission line are identified by location in Table 3.13-12. Construction of the Applicant Proposed Route should not have significant adverse impacts on local and regional medical facilities and services. The temporary relocation of workers and family members to the counties in the ROI is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

The numbers of workers expected to temporarily relocate with their families during construction of the Applicant Proposed Route are identified by Region in Table 3.13-36. Table 3.13-36 also identifies the projected peak and average number of school-age children expected to temporarily relocate to each Region, and compares the peak estimates with the existing number of students in each Region. The projected peak number of school children temporarily relocating to the area would be equivalent to approximately 0.01 percent (Region 7) to 0.13 percent (Region 1) of the existing enrollment in school districts in the regions and would have no noticeable effect on existing average student/teacher ratios (Table 3.13-36).

Table 3.13-36 also summarizes the estimated temporary increase in school-age children if construction of the converter stations, AC collection system routes, and Applicant Proposed Route were to all peak at the same time. This increase would affect Regions 1 and 7 and result in increases in school-age children equivalent to 0.57 percent and 0.03 percent of existing enrollment, respectively (Table 3.13-36). These increases would not be expected to affect existing average student/teacher ratios in these regions.

Table 3.13-36:
Projected Construction-Related Demand for Education Resources by Region

Region	1	2	3	4	5	6	7
Applicant Proposed Route							
Projected Non-Local Employment[1]							
Average Employment (Jobs/Week)	119	112	182	130	142	47	32
Peak Employment (Jobs/Week)	168	158	255	182	200	66	46
Projected Number of School Age Children[2]							
Average	12	11	18	13	14	5	3
Peak	17	16	26	18	20	7	5
Estimated Education Resources							
Number of Schools	66	52	177	68	119	21	87
Number of Students	12,701	16,012	57,993	27,456	51,455	7,673	65,177
Number of Teachers	1,312	1,455	5,294	2,112	3,875	611	4,117
Student/Teacher Ratio (average)	9.7	11.0	11.0	13.0	13.3	12.6	15.8
Peak Comparison with Existing Student Numbers							
Percent of Existing Students	0.13%	0.10%	0.04%	0.07%	0.04%	0.09%	0.01%
Applicant Proposed Route, Converter Stations, and AC Collection System Routes							
Projected Number of School Age Children[2]							
Peak	73	16	26	18	20	7	23
Peak Comparison with Existing Student Numbers							
Percent of Existing Students	0.57%	0.10%	0.04%	0.07%	0.04%	0.09%	0.03%

1 An estimated 74 percent of the total construction workforce is assumed to be non-local for the duration of the Project.
2 Projected numbers of school children are based on the assumptions that 10 percent of workers would be accompanied by their families; the average family household includes 1.0 child under the age of 18 years; and all children relocating to the area would be of school age.

3.13.6.2.6.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC and AC transmission lines would employ 32 workers in Oklahoma, including 15 in Guymon, Oklahoma (Texas County) (Region 1), seven in Woodward, Oklahoma (Region 2), and 10 in Muskogee, Oklahoma (Region 3). An additional 10 workers would be employed in Newport, Arkansas (Jackson County) (Region 6). Even if these workers were to relocate to the affected counties from outside the respective region, the associated increase in population would not be expected to noticeably affect the provision of community services.

Operations and maintenance of the converter station in Texas County, Oklahoma, would employ up to 15 workers. If these workers and those required to operate and maintain the HVDC and AC transmission lines in Texas County were all to permanently relocate to the area from elsewhere, these combined staffing levels would still not be expected to have a noticeable impact on community services. The operations and maintenance employees associated with Tennessee converter station would not be expected to reside in the same counties as the HVDC transmission line staff.

3.13.6.2.6.3.3 Decommissioning Impacts

Decommissioning the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.2.7 Tax Revenues

3.13.6.2.7.1 Converter Stations and AC Interconnection Siting Areas

3.13.6.2.7.1.1 Construction Impacts

Construction of the converter stations would generate sales, use, and lodging tax revenue during the construction period. According to the Applicant, approximately 90 percent of the total estimated construction costs of $250 million for each station would be for materials subject to sales and use tax in Oklahoma and Tennessee, respectively. Estimated sales and use tax revenues are summarized for the two converter stations in Table 3.13-37. Estimated state and county revenues are higher for the Tennessee converter station because the sales and use tax rates are higher in Tennessee and Shelby and Tipton counties (see Tables 3.13-14 and 3.13-17). These revenues would be generated over the 32-month construction period projected for each converter station. The Oklahoma and Tennessee converter stations would be located in Regions 1 and 7, respectively. Local spending by construction workers would also generate sales and lodging tax revenues, but the amount and distribution of this type of spending is difficult to accurately forecast. These potential revenues are not estimated here.

Table 3.13-37:
Estimated Sales and Use Tax Revenues from Converter Station Construction ($ million)

Converter Station[1]	Total Estimated Cost[2]	Estimated State Revenues	Estimated County Revenues
Oklahoma	$250	$10.1	$2.3
Tennessee[1]	$250	$15.8	$5.1

1 The proposed Tennessee converter station could be constructed in either Shelby or Tipton counties, Tennessee. The state and county sales and use tax rates are the same in both counties.
2 Total estimated costs are from Clean Line (2013).

3.13.6.2.7.1.2 Operations and Maintenance Impacts

Operations of the converter stations would generate annual property or ad valorem tax revenues in the counties where they would be located. Using a simplified cost approach and an assumed value of $250 million (Clean Line 2013), annual ad valorem or property tax revenues generated by the Oklahoma converter station would range from $3.2 million to $4.6 million. These estimates are based on Oklahoma's assessment ratio (the share of assessed value subject to taxation) of 22.85 percent and the low and high millage rates identified for Texas County in 2012 (Table 3.13-19).

Annual ad valorem or property taxes associated with the Tennessee converter station would vary depending on whether the station is located in Shelby or Tipton county. Using an assumed value of $250 million (Clean Line 2013), the state's assessment ratio for utility property (55 percent), the applicable county appraisal ratios and average millage rates per $1,000 of assessed value by county (40.6 and 23.4 for Shelby and Tipton counties, respectively), results in estimated annual ad valorem tax revenues of $5.6 million and $3.4 million, respectively.

3.13.6.2.7.1.3 Decommissioning Impacts

Decommissioning the Project would involve local expenditures for supplies and services and would likely require the temporary influx of construction workers to remove the Project components. This spending would be expected to generate local sales and use tax. It is not possible to estimate approximate values, but adjusted for inflation, tax revenues would likely be generally equivalent to those estimated for construction, other conditions remaining equal. Removal of the Project would reduce the value of the affected property and result in a net reduction in ad valorem and property taxes, generally equivalent to the estimates developed for Project operations.

3.13.6.2.7.2 AC Collection System

3.13.6.2.7.2.1 Construction Impacts

The Applicant estimates that the AC transmission lines would cost $1 million to build per mile with 90 percent of this cost expected to be subject to sales and use tax in the affected states and counties (Clean Line 2014a). Estimated state sales and use tax revenues in Oklahoma range from $0.2 million for AC Collection System Routes SE-2 and SW-1 to $2.5 million for AC Collection System Route Alternative NW-2 (Table 3.13-38). Five of the alternatives are located in Texas counties. Estimated state sales and use tax for those alternatives ranges from $0.6 million (AC Collection System Routes SE-2 and SW-1) to $1.4 million (AC Collection System Routes SE-1 and SW-2). These revenues would be generated over the construction period for each alternative.

Table 3.13-38:
Estimated State Sales and Use Tax Revenues by AC Collection System Route ($ million)

County/ Alternative	Oklahoma[1]				Texas[1]			
	Beaver	Texas	Cimarron	Total	Hansford	Ochiltree	Sherman	Total
E-1	0.2	1.1		1.3				
E-2	0.7	1.1		1.8				
E-3	0.7	1.1		1.8				
NE-1		1.4		1.4				
NE-2		1.2		1.2				
NW-1		2.3	0.1	2.3				
NW-2		2.4	0.1	2.5				
SE-1		0.8		0.8	0.1	1.2		1.4
SE-2		0.2		0.2	0.6			0.6
SE-3	0.1	1.1		1.2		1.3		1.3
SW-1		0.2		0.2	0.6			0.6
SW-2		0.7		0.7	0.2		1.2	1.4
W-1		0.9		0.9				

1 Estimates in this table are for sales and use tax revenues that would be paid to the state. The affected counties in Oklahoma also levy additional sales, use, and lodging taxes (see Table 3.13-15). Estimated county sales and use revenues are not included in this table.

Counties and other local jurisdictions in Texas and Oklahoma are allowed to levy additional sales, use, and lodging taxes within their jurisdictions. Although most counties in Texas levy an additional 0.5 percent sales and use tax, none of the Texas counties in Region 1 currently levy a local sales and use tax (Table 3.13-14). As a result, the AC collection system routes that cross counties in Texas would not generate sales and use tax revenues for those counties.

Sales and use taxes levied by Oklahoma counties are identified in Table 3.13-15 and range from 1 percent to 2 percent in the Oklahoma counties in Region 1. Estimated sales and use tax revenues generated for Texas County would range from less than $0.1 million (AC Collection System Routes SE-2 and SW-1) to $0.5 million (AC Collection System Route NW-1). Four routes cross Beaver County. Sales and use tax revenues generated for that county would range from $0.1 million (AC Collection System Route SE-3) to about $0.7 million (AC Collection System Routes E-2 and E-3). Two routes cross Cimarron County (AC Collection System Routes NW-1 and NW-2) and would each generate less than $0.1 million in county sales and use tax revenues.

Local spending by construction workers would also generate sales and lodging tax revenues, but the amount of spending and distribution by county is difficult to accurately forecast, so these potential revenues are not estimated here.

3.13.6.2.7.2.2 Operations and Maintenance Impacts

Operations and maintenance of the AC collection transmission lines would generate annual property or ad valorem tax revenues in the counties where they would be located. Using a simplified cost approach and an assumed value of $1 million per mile (Clean Line 2014a), annual ad valorem or property tax revenues estimates are presented by alternative and county in Table 3.13-39.

Estimates for the affected Oklahoma counties (Beaver, Texas, and Cimarron counties) are based on the state assessment ratio (the share of assessed value subject to taxation) of 22.85 percent and the low and high millage rates identified for each county in 2012 (Table 3.13-19). Estimated low ad valorem tax revenues generated for Texas County range from less than $0.1 million (AC Collection System Routes SE-2 and SW-1) to $0.6 million (AC Collection System Route NW-1). Estimated high revenues would range from less than $0.1 million (AC Collection System Routes SE-2 and SW-1) to about $1 million (AC Collection System Route NW-2) (Table 3.13-39).

Low ad valorem tax revenues estimated for Beaver County range from less than $0.1 million (AC Collection System Routes E-1 and SE-3) to about $0.2 million (AC Collection System Routes E-2 and E-3). High estimates range from less than $0.1 million (AC Collection System Route E-1) to about $0.25 million (AC Collection System Route E-3). Two routes cross Cimarron County (AC Collection System Routes NW-1 and NW-2) and would each generate less than $0.1 million in ad valorem tax revenues under the low and high tax scenarios (Table 3.13-39).

Table 3.13-39:
Estimated Ad Valorem Tax Revenues by AC Collection System Route and County in Oklahoma ($ million)

County/Alternative	Low Ad Valorem Tax Estimate[1]			High Ad Valorem Tax Estimate[1]		
	Beaver	Texas	Cimarron	Beaver	Texas	Cimarron
E-1	0.05	0.32		0.06	0.46	
E-2	0.18	0.31		0.24	0.45	
E-3	0.19	0.30		0.25	0.44	
NE-1		0.38			0.55	
NE-2		0.33			0.48	
NW-1		0.64	0.02		0.93	0.02
NW-2		0.47	0.03		0.68	0.03
SE-1		0.24			0.35	
SE-2		0.05			0.07	
SE-3	0.04	0.31		0.05	0.45	
SW-1		0.05			0.07	
SW-2		0.19			0.28	
W-1		0.26			0.38	

1 Low and high ad valorem tax revenues are estimated based on an assumed value of $1 million per mile (Clean Line 2014a), the state assessment ratio, and county specific low and high millage rates.

Estimated ad valorem revenues for the potentially affected counties in Texas are presented in Table 3.13-40. Estimated values range from less than $0.1 million in Hansford and Ochiltree counties to $0.1 million in Ochiltree County (AC Collection System Route SE-3). Values are estimated using the average county millage rates for 2012 (see Table 3.13-18).

Table 3.13-40:
Estimated Ad Valorem Tax Revenues by AC Collection System Route and County in Texas ($ million)

County/Alternative	SE-1	SE-2	SE-3	SW-1	SW-2
Hansford, TX	0.01	0.04		0.04	0.01
Ochiltree, TX	0.08		0.09		
Sherman, TX					0.1

3.13.6.2.7.2.3 Decommissioning Impacts

The general tax implications of decommissioning the AC collection system routes would be similar to those discussed above with respect to the converter stations.

3.13.6.2.7.3 HVDC Applicant Proposed Route

3.13.6.2.7.3.1 Construction Impacts

Construction of the transmission line would generate sales and use tax during the construction period. The Applicant estimates that the transmission line would cost $2 million to build per mile with 90 percent of this cost expected to be subject to sales and use tax in the affected states and counties (Clean Line 2013). Estimated sales and tax revenues are presented by county in Table 3.13-41. These estimates are based on the miles of transmission line proposed for each county and the applicable state and county sales and use tax rates (see Tables 3.13-15, 3.13-16, and 3.13-17).

Total estimated state sales and use tax revenues range from $2.1 million in Tennessee to $34.6 million in Oklahoma; the estimated total for Arkansas would be $32.3 million. Estimated county sales and use tax revenues generated for the affected counties in Oklahoma range from $0.05 million in Kingfisher County to $2.0 million in Beaver County. In Arkansas, estimated sales and use tax revenues generated for the affected counties range from $0.5 million in several different counties to $1.4 million in Jackson County. The transmission line would generate an estimated $0.2 million in county sales and use tax revenues in Shelby County and $0.5 million in Tipton County (Table 3.13-41). These revenues would be generated over the construction period for each transmission line segment.

Table 3.13-41:
Estimated Sales and Use Tax Revenues from HVDC Transmission Line Construction ($ million)

County	Total Estimated Cost	Estimated State Revenues	Estimated County Revenues
Region 1			
Texas, OK	$47.6	$1.9	$0.4
Beaver, OK	$112.0	$4.5	$2.0
Harper, OK	$71.3	$2.9	$1.3
Region 2			
Woodward, OK	$64.8	$2.6	$0.8
Major, OK	$104.3	$4.2	$0.2
Garfield, OK	$44.3	$1.8	$0.1
Region 3			
Kingfisher, OK	$6.7	$0.3	$0.0
Logan, OK	$41.6	$1.7	$0.4
Payne, OK	$71.5	$2.9	$0.5
Lincoln, OK	$19.9	$0.8	$0.2
Creek, OK	$54.9	$2.2	$0.5
Okmulgee, OK	$55.4	$2.2	$0.6
Muskogee, OK	$79.0	$3.2	$0.5

Table 3.13-41:
Estimated Sales and Use Tax Revenues from HVDC Transmission Line Construction ($ million)

County	Total Estimated Cost	Estimated State Revenues	Estimated County Revenues
Region 4			
Sequoyah, OK	$79.9	$3.2	$1.0
Crawford, AR	$56.9	$3.3	$0.5
Franklin, AR	$39.7	$2.3	$0.5
Johnson, AR	$55.6	$3.3	$0.5
Region 5			
Pope, AR	$54.3	$3.2	$0.5
Conway, AR	$43.2	$2.5	$0.7
Van Buren, AR	$26.5	$1.5	$0.5
Cleburne, AR	$47.0	$2.7	$0.7
White, AR	$34.4	$2.0	$0.5
Jackson, AR	$67.3	$3.9	$1.4
Region 6			
Poinsett, AR	$63.0	$3.7	$0.7
Cross, AR	$32.2	$1.9	$0.6
Region 7			
Mississippi, AR	$32.7	$1.9	$0.6
Shelby, TN	$10.0	$0.6	$0.2
Tipton, TN	$22.8	$1.4	$0.5

Local spending by construction workers would also generate sales and lodging tax revenues, but the amount of spending and distribution by county is difficult to accurately forecast, so these potential revenues are not estimated here. If construction of all three Project components—converter stations, AC transmission lines, and the HVDC transmission line—were to occur at the same time, combined sales and use totals in Beaver and Texas counties, Oklahoma, and Shelby or Tipton County, Tennessee, would result, depending on the final location of the Tennessee converter station. Combined sales and use tax revenue estimates are presented in Table 3.13-42. These estimates are based on a number of assumptions (see the table footnotes) and provide an illustration of the potential combined impacts.

Table 3.13-42:
Estimated Combined Sales and Use Tax Revenues from Converter Stations, AC Collection System, and HVDC Transmission Line Construction ($ million)

County	Estimated County Revenues[1]			
	Converter Stations[2]	AC Collection System[3]	HVDC Transmission Line	Total
Texas, OK	$2.3	$1.4	$0.4	$4.1
Beaver, OK		$0.8	$2.0	$2.8
Shelby, TN	$5.1		$0.2	$5.3
Tipton, TN	$5.1		$0.5	$5.5

1 Data are combined estimates of the sales and use tax revenues that would accrue to each county and do not include sales and use tax that would be paid to the state (see the above tables).
2 The proposed Tennessee converter station could be constructed in either Shelby or Tipton counties, Tennessee. The county sales and use tax rates are the same in both counties.
3 The combined totals for Beaver and Texas counties would vary depending on the selected AC collection system routes. Estimates are based on six alternative AC transmission lines of average length, with four assumed to be partially located in Beaver County.

3.13.6.2.7.3.2 Operations and Maintenance Impacts

Operations and maintenance of the HVDC transmission line would generate annual property or ad valorem tax revenues in the counties where it would be located. Using a simplified cost approach and an assumed value of $2 million per mile (Clean Line 2013), annual ad valorem or property tax revenues estimates are presented by county in Tables 3.13-43.

Estimates for the affected Oklahoma counties are based on the state assessment ratio (the share of assessed value subject to taxation) of 22.85 percent and the low and high millage rates identified for each county in 2012. The low estimates range from about $0.1 million in Kingfisher County (Region 3) to $1.9 million in Major County (Region 2). High estimates range from $0.2 million in Kingfisher County to $2.4 million in Major County (Table 3.13-43).

Table 3.13-43:
Estimated Ad Valorem Tax Revenues for the HVDC Transmission Line by County in Oklahoma ($ million)

Region/County	Total Estimated Cost	Low Millage (2012)	High Millage (2012)	Low Estimate[1]	High Estimate[1]
Region 1					
Texas, OK	$47.6	55.60	80.73	$0.6	$0.9
Beaver, OK	$112.0	52.19	67.94	$1.3	$1.7
Harper, OK	$71.3	57.00	86.36	$0.9	$1.4
Region 2					
Woodward, OK	$64.8	63.64	93.10	$0.9	$1.4
Major, OK	$104.3	78.89	100.12	$1.9	$2.4
Garfield, OK	$44.3	80.29	103.61	$0.8	$1.0
Region 3					
Kingfisher, OK	$6.7	77.99	105.94	$0.1	$0.2
Logan, OK	$41.6	76.29	119.76	$0.7	$1.1
Payne, OK	$71.5	73.67	102.61	$1.2	$1.7
Lincoln, OK	$19.9	73.75	99.11	$0.3	$0.5
Creek, OK	$54.9	73.98	120.55	$0.9	$1.5
Okmulgee, OK	$55.4	80.68	97.29	$1.0	$1.2
Muskogee, OK	$79.0	74.96	100.40	$1.4	$1.8
Region 4					
Sequoyah, OK	$79.9	68.50	84.33	$1.2	$1.5

1 Low and high ad valorem tax revenues are estimated based on an assumed value of $2 million per mile (Clean Line 2014a), the state assessment ratio, and county-specific low and high millage rates.

Estimated annual ad valorem tax revenues are presented for the affected counties in Arkansas and Tennessee in Table 3.13-44. Estimates for Arkansas counties are based on the state assessment ratio (the share of assessed value subject to taxation) of 20 percent and the average millage rates identified for each county in 2012. Estimates range from $0.2 million in Van Buren County to about $0.6 million in Crawford, Jackson, and Poinsett counties (Table 3.13-44).

Annual ad valorem or property taxes are estimated for Shelby and Tipton counties, Tennessee, using the state's assessment ratio for utility property (55 percent), the applicable county appraisal ratios, and the average millage rates identified for each county in 2012. The transmission line would generate about $0.2 million and $0.3 million in annual ad valorem tax revenues in Shelby and Tipton counties, respectively (Table 3.13-44).

Table 3.13-44:
Estimated Ad Valorem Tax Revenues for the HVDC Transmission Line by County in Arkansas and Tennessee ($ million)

Region/County/State[1, 2]	Total Estimated Cost	Average Millage Rates (2012)	Estimated Ad Valorem Tax Revenues
Region 4			
Crawford, AR	$56.9	49.11	$0.6
Franklin, AR	$39.7	46.79	$0.4
Johnson, AR	$55.6	47.96	$0.5
Region 5			
Pope, AR	$54.3	45.98	$0.5
Conway, AR	$43.2	46.53	$0.4
Van Buren, AR	$26.5	43.90	$0.2
Cleburne, AR	$47.0	41.94	$0.4
White, AR	$34.4	43.01	$0.3
Jackson, AR	$67.3	46.65	$0.6
Region 6			
Poinsett, AR	$63.0	44.47	$0.6
Cross, AR	$32.2	49.89	$0.3
Region 7			
Mississippi, AR	$32.7	49.70	$0.3
Shelby, TN	$10.0	4.06	$0.2
Tipton, TN	$22.8	2.34	$0.3

1 Estimates for Arkansas counties are based on the state assessment ratio (the share of assessed value subject to taxation) of 20 percent and the average millage rates identified for each county.
2 Estimates for Tennessee are based on the state's assessment ratio for utility property (55 percent), the applicable county appraisal ratios, and the average millage rates identified for each county.

The proposed locations of the three Project components—converter stations, AC transmission lines, and the HVDC transmission line—would result in combined ad valorem tax estimates for Beaver and Texas counties, Oklahoma, and Shelby or Tipton County, Tennessee, depending on the location of the Tennessee converter station. Based on the preceding analyses, combined ad valorem tax revenues would range from $4.5 million to $6.5 million in Texas County and from $1.8 million to $2.3 million in Beaver County. Combined estimates for Shelby and Tipton counties in Tennessee are $5.8 million and $3.7 million, respectively.

3.13.6.2.7.3.3 Decommissioning Impacts

The general tax implications of decommissioning the HVDC transmission line would be similar to those discussed above with respect to the converter stations.

3.13.6.3 Impacts Associated with the DOE Alternatives

3.13.6.3.1 Arkansas Converter Station Alternative Siting Area and AC Interconnection Siting Area

3.13.6.3.1.1 Construction Impacts

The Applicant has indicated that the Arkansas Converter Station Alternative Siting Area, which would be located in Region 5 in either Pope County or Conway County, would cost an estimated $100 million to construct and require a similar labor force to that required to build the Oklahoma and Tennessee converter stations (Figure 3.13-2).

3.13.6.3.1.1.1 Population

Based on the assumptions outlined in 3.11.5.2.1.1.1, an estimated average of 123 people would temporarily relocate to the vicinity of the Arkansas converter station over the 32-month construction period, with an estimated total of 213 people relocating during the peak construction period (months 12 to 17). Depending on the location, the average increase in population would be equivalent to approximately 0.2 percent and 0.6 percent of the existing (2012) population in Pope and Conway counties, respectively. The peak increase would be equivalent to approximately 0.3 percent and 1.0 percent of the respective existing (2012) populations in Pope and Conway counties. Very few, if any, of the non-local workers employed during the construction phase of the converter station projects would be expected to permanently relocate to the affected areas, so it is unlikely that construction of the converter stations would result in any long-term changes in population.

3.13.6.3.1.1.2 Economic Conditions

Construction of the Arkansas Converter Station Alternative Siting Area would result in a temporary increase in employment and earnings in the local area. This construction is expected to cost approximately $100 million and employ an average of 138 workers over the 32-month construction period, with total estimated employee earnings of $16.2 million. Construction of the converter station would support an estimated average of 244 total (direct, indirect, and induced) jobs and generate a total of $27.1 million in earnings over the course of the 32-month construction period (Table 3.12-45). Indirect and induced jobs and earnings are estimated at the state level using multipliers for the state of Arkansas.

Table 3.13-45:
Total Economic Impacts from Construction of the Arkansas Converter Station Alternative

Impacts	Employment (Jobs)	Annual Earnings	Earnings Over the Construction Period[1]
Direct Impact	138	$6.1	$16.2
Indirect and Induced Impacts[2]	106	$4.1	$10.9
Total Impacts	244	$10.2	$27.1

1 Construction is expected to take place over a 32-month period.
2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct effect multipliers for the state of Arkansas (BEA 2013b).

3.13.6.3.1.1.3 Housing

Projected peak housing demand for the Arkansas Converter Station Alternative Siting Area is compared with estimated supply in Region 5 and Pope and Conway counties in Table 3.13-46. The analyses presented for Pope and Conway counties each assume that the converter station would be located in that county. The data presented in Table 3.13-46 suggest that adequate temporary housing would be available to accommodate Project demand in Region 5. This would also likely be the case for Pope County alone. Estimated demand for hotel and motel rooms would exceed the available units in Conway County, but rooms are available in adjacent counties in Region 5, as well as the cities of Little Rock and North Little Rock to the south.

Table 3.13-46:
Projected Construction-Related Housing Demand for the Arkansas Converter Station Alternative

Housing Demand and Supply	Region 5	Pope County[1]	Conway County[1]
Projected Peak Housing Demand[2]			
Rental Housing	36	36	36
Hotel and Motel Rooms	81	81	81
RV Spaces	63	63	63

Table 3.13-46:
Projected Construction-Related Housing Demand for the Arkansas Converter Station Alternative

Housing Demand and Supply	Region 5	Pope County[1]	Conway County[1]
Estimated Available Housing Units[3]			
Rental Housing[4]	4,207	878	436
Hotel and Motel Rooms[5]	1,137	269	61
RV Spaces	633	177	142
Projected Demand as Share of Existing Resources			
Rental Housing	1%	4%	8%
Hotel and Motel Rooms	7%	30%	133%
RV Spaces	10%	35%	44%

1 The proposed Arkansas converter station would be located in either Pope or Conway counties.
2 Projected housing demand is assumed to be divided as follows: rental housing (apartments, houses, or mobile homes) (20 percent), hotel and motel rooms (45 percent), and RV spaces (35 percent).
3 Estimated available housing units are presented by county in Table 3.13-10.
4 Many of these available units include more than one bedroom and, if rented, could be occupied by more than one worker. A large number of in-migrating workers on similar projects typically rent a room in a house or live five in a rented house (BLM 2013).
5 Assumes an average occupancy rate of 75 percent for the purposes of analysis, with 25 percent of total units assumed to be potentially available.

3.13.6.3.1.1.4 Community Services

The potential temporary addition of non-local workers to Pope or Conway counties, which would be equivalent to either 0.3 percent or 1.0 percent of their respective existing (2012) populations, is not expected to affect the levels of service provided by existing law and fire protection personnel. The number of law enforcement and fire departments per county are identified in Table 3.13-11. Increased demands for local services that could occur from construction workers and family members temporarily relocating to the area would be short term.

The closest medical centers to the two Arkansas Converter Station Alternative Siting Area locations are St. Mary's Regional Medical Center (Pope County) and St. Vincent Morrilton (Conway County). Both facilities provide emergency room services and St. Mary's has a medical helicopter pad (Table 3.13-12). The temporary relocation of workers and family members to Pope or Conway counties is not expected to affect existing levels of health care and medical services. Minor increases in demands for local services that could occur from workers and family members temporarily relocating to the area would be short term.

An average and peak of 10 and 18 school-age children, respectively, are expected to temporarily relocate to the affected county during construction the converter station alternative. This minor potential increase in the number of students is not expected to affect existing average student/teacher ratios in either Pope or Conway counties (Table 3.13-13).

3.13.6.3.1.1.5 Tax Revenues

Construction of the Arkansas Converter Station Alternative Siting Area would generate sales, use, and lodging tax revenue during the construction period. According to the Applicant, approximately 90 percent of the total estimated construction costs of $100 million would be for materials subject to sales and use tax in Arkansas (Clean Line 2013). Estimated state sales and use tax revenues would be $5.9 million in either county; estimated county revenues would be higher if the converter station were located in Conway County, rather than Pope County, $1.6 million versus $0.9 million (Table 3.13-47).

Table 3.13-47:
Estimated Sales and Use Tax Revenues from Construction of the Arkansas Converter Station Alternative($ million)

County[1]	Total Estimated Cost	Estimated State Revenues	Estimated County Revenues
Pope	$100	$5.9	$0.9
Conway	$100	$5.9	$1.6

1 The proposed Arkansas Converter Station alternative could be constructed in either Pope or Conway counties.

3.13.6.3.1.2 Operations and Maintenance Impacts

3.13.6.3.1.2.1 Population

Operations and maintenance of the converter station is expected to employ up to 15 workers. These estimated staffing levels would have no noticeable impact on existing population levels in Pope or Conway counties.

3.13.6.3.1.2.2 Economic Conditions

Operations and maintenance of the Arkansas converter station would support up to 15 workers, with estimated annual earnings of approximately $1 million. Operations and maintenance activities would support an estimated total (direct, indirect, and induced) of 37 jobs and $1.7 million in annual earnings (Table 3.13-48). Indirect and induced jobs and earnings are estimated at the state level using multipliers for the state of Arkansas.

Table 3.13-48:
Total Annual Economic Impacts from Operations and Maintenance of the Arkansas Converter Station Alternative

Impacts	Employment (Jobs)	Annual Earnings ($ million)[1]
Direct Impact	15	$1.02
Indirect and Induced Impacts[2]	22	$0.63
Total Impacts	37	$1.65

1 Total earnings were estimated based on the 2012 estimate of $67,950 for the annual average wage across the United States for all occupations in the electric power generation, transmission, and distribution industry (BLS 2012).
2 Indirect and induced impacts are estimated using the U.S. Bureau of Economic Analysis RIMS II direct-effect multipliers for the state of Oklahoma (BEA 2013b).

3.13.6.3.1.2.3 Housing

The potential relocation of up to 15 workers to Pope or Conway counties would have no noticeable impact on existing demand for housing in the potentially affected counties.

3.13.6.3.1.2.4 Community Services

If up to 15 workers and their families were to relocate from elsewhere, the resulting very small increase in population would not be expected to noticeably affect the provision of community services.

3.13.6.3.1.2.5 Tax Revenues

Operations and maintenance of the Arkansas converter station would generate annual property or ad valorem tax revenues in either Pope or Conway counties, depending on where it is located. Using a simplified cost approach and an assumed value of $100 million (Clean Line 2013), annual ad valorem or property tax revenues generated by the converter station would be about $0.9 million in either county. These estimates are based on Arkansas' assessment ratio of 20 percent and the 2012 millage rates for Pope and Conway counties (Table 3.13-20).

3.13.6.3.1.3 Decommissioning Impacts

Decommissioning the converter station would require a labor force approximately equal to that needed for its construction. Impacts to population, economic conditions, housing, and community services from decommissioning are, therefore, expected to be similar to those from construction. Decommissioning of the Arkansas converter station and associated transmission line would be expected to generate local sales and use tax, which, adjusted for inflation, would likely be generally equivalent to those estimated for construction, other conditions remaining equal. Removal of the converter station would reduce the value of the affected property and result in a net reduction in ad valorem and property taxes, generally equivalent to the estimates developed for Project operations and maintenance.

3.13.6.3.2 HVDC Alternative Routes

The HVDC alternative routes and their net change in length relative to the Applicant Proposed Route are presented in Table 3.13-49. These alternatives are mainly alternatives to sections of the Applicant Proposed Route in each region, not complete alternative routes.

3.13.6.3.2.1 Construction Impacts

3.13.6.3.2.1.1 Population

Viewed by region, proposed changes in length range from a decrease of 2.7 miles in Region 4 (HVDC Alternative Route 4-B) to an increase of 10.6 miles and 14.7 miles in Region 7 (HVDC Alternative Routes 7-C and 7-A, respectively) (Table 3.13-49). HVDC Alternative Route 1-A would also result in a relative large increase, a net gain of 9.4 miles. Net changes to the projected temporary peak increases in population summarized in Table 3.13-23, range from decreases of about 5 people in Region 3 (HVDC Alternative Route 3-A) and Region 4 (HVDC Alternative Route 4-B) to increases of 16 people in Region 1 (HVDC Alternative Route 1-A) and 19 people in Region 7 (HVDC Alternative Route 7-A) (Table 3.13-49). These changes would have very small to no effect on the estimated changes in population summarized Table 3.13-23.

3.13.6.3.2.1.2 Economic Conditions

Substituting one or more of the HVDC alternative routes for the corresponding links of the Applicant Proposed Route would not substantially affect the regional economic impact estimates presented by region in Tables 3.13-25 and 3.13-26. Estimated changes in peak direct employment (local and non-local workers) by HVDC alternative route would range from -5 workers in Region 3 (HVDC Alternatives 3-A and 3-B) to 21 workers in Region 7 (HVDC Alternative Route 7-A) and 19 workers in Region 1 (HVDC Alternative Route 1-A) (Table 3.13-49).

3.13.6.3.2.1.3 Housing

The net change in the number of people who would temporarily relocate to each region, relative to the Applicant Proposed Route, is identified by HVDC alternative route in Table 3.13-49. The largest net increases would occur in Region 1 with the addition of 16 people (HVDC Alternative Route 1-A) and Region 7 where 14 and 19 more people could be added (HVDC Alternative Routes 7-C and 7-A, respectively). Substituting one of more of the HVDC alternative routes for the corresponding section of the Applicant Proposed Route would not substantially affect the findings of the housing analysis summarized in Section 3.13.5.2.4.

3.13.6.3.2.1.4 Community Services

The estimated net changes in workers and family members temporarily relocating to the affected regions identified in Table 3.13-49 are not expected to alter the conclusions presented with respect to the Applicant Proposed Route and community services in Section 3.13.5.2.6. The majority of the HVDC alternative routes would not affect the peak number of school age children temporarily relocating to the affected regions. In other cases, there would be a potential increase of one to two school-age children relative to the Applicant Proposed Route for that region (Table 3.13-49).

Table 3.13-49:
HVDC Alternative Routes by Region

Region	Miles by Region	Net Change in Length (miles)	Percent Change in Length[2]	Estimated Change Relative to Applicant Proposed Route During Construction[1]			
				Peak Employment (Local and Non-Local Workers)	Non-Local Workers Temporarily Relocating	Total Number of People Temporarily Relocating	Number of School Age Children
Region 1	115.5						
AR 1-A		9.4	8%	19	14	16	1
AR 1-B		-2.0	-2%	-4	-3	-3	0
AR 1-C		-1.8	-2%	-4	-3	-3	0
AR 1-D		-0.1	0%	0	0	0	0
Region 2	106.0						
AR 2-A		2.7	3%	5	4	5	0
AR 2-B		-1.5	-1%	-3	-2	-3	0
Region 3	161.7						
AR 3-A		-2.4	-1%	-5	-4	-5	0
AR 3-B		-2.2	-1%	-5	-3	-4	0
AR 3-C		3.1	2%	7	5	6	0
AR 3-D		4.2	3%	9	7	8	1
AR 3-E		0.8	0%	2	1	1	0
Region 4	126.3						
AR 4-A		-2.0	-2%	-4	-3	-3	0
AR 4-B		-2.7	-2%	-5	-4	-5	0
AR 4-C		1.2	1%	2	2	2	0
AR 4-D		0.0	0%	0	0	0	0
AR 4-E		-2.0	-2%	-4	-3	-3	0
Region 5	112.8						
AR 5-A		0.4	0%	1	1	1	0
AR 5-B		3.9	3%	9	7	8	1
AR 5-C		4.7	4%	11	8	10	1
AR 5-D		1.2	1%	3	2	3	0
AR 5-E		3.2	3%	8	6	7	1
AR 5-F		3.6	3%	9	6	8	1
Region 6	54.3						
AR 6-A		-1.5	-3%	-2	-2	-2	0
AR 6-B		4.5	8%	7	5	7	1
AR 6-C		-1.7	-3%	-3	-2	-2	0
AR 6-D		0.6	1%	1	1	1	0
Region 7	42.8						
AR 7-A		14.7	34%	21	16	19	2
AR 7-B		0.2	1%	0	0	0	0
AR 7-C		10.6	25%	15	11	14	1
AR 7-D		0.1	0%	0	0	0	0

1 Estimated changes relative to the Applicant Proposed Route are based on the per-mile values of the affected resource category by region.
2 Percent change is the net change in length as a percent of the total miles per region.

3.13.6.3.2.1.5 Tax Revenues

Changes in the projected length of the transmission line by county would result in corresponding changes in construction-related sales and use tax revenues expected to accrue to the affected counties and states. Net changes in estimated sales and use tax revenues, relative to the Applicant Proposed Route, are identified by county in Table 3.13-50. In most cases, the miles of transmission line in each county are affected by more than one alternative. The largest estimated change (positive or negative) relative to the Applicant Proposed Route is identified by county in Table 3.13-50 to ensure that the largest potential variation is considered in the following assessment.

Viewed as a relative share of the Applicant Proposed Route, estimated changes in miles of HVDC transmission line by county would range from less than 1 percent to 257 percent. In four counties the largest change relative to the Applicant Proposed Route would be a 100 percent decrease because the corresponding HVDC alternative route would no longer cross that county. The four counties that would no longer be crossed are Kingfisher County, Oklahoma (Region 3), Van Buren and Cleburne counties, Arkansas (Region 5), and Cross County, Arkansas (Region 6). Two of the alternative routes for Region 5 (HVDC Alternative Routes 5-B and 5-E) would cross Faulkner County, Arkansas, which is not crossed by the Applicant Proposed Route. The largest change for Faulkner County would occur under HVDC Alternative 5-E, which would involve construction of 21.8 miles of HVDC transmission line across the county (Table 3.13-50).

Relative to the Applicant Proposed Route, the largest changes in estimated sales and use tax revenue that would accrue to the respective state would occur in counties in Region 5 and range from a decrease of $2.75 million (-100 percent) in Cleburne County to an increase of $2.55 million (100 percent) in Faulkner County. Changes in estimated sales and use tax that would be paid to each county would range from a decrease of about $0.7 million in Cleburne County, Arkansas (Region 5) to an estimated increase of $0.5 million in Shelby County, Tennessee (Region 7) (Table 3.13-50).

Table 3.13-50:
Estimated Tax Revenues by HVDC Alternative Route and County

County	Total Crossed by Applicant Proposed Route	Largest Net Change (miles)[1]	Percent Change in Miles	Estimated Change Relative to the Applicant Proposed Route: Construction Phase Sales and Use Tax Revenues ($ million) – State	Construction Phase Sales and Use Tax Revenues ($ million) – County	Ad Valorem and Property Tax Revenues ($ million)[2]
Region 1						
Texas, OK	23.8	1.4	6%	$0.11	$0.03	$0.04
Beaver, OK	56.0	4.3	8%	$0.35	$0.15	$0.12
Harper, OK	35.6	3.8	11%	$0.31	$0.14	$0.12
Region 2						
Woodward, OK	32.4	-0.9	-3%	-$0.07	-$0.02	-$0.03
Major, OK	52.2	3.6	7%	$0.29	$0.02	$0.15
Garfield, OK	22.2	1.6	7%	$0.13	$0.01	$0.07
Region 3						
Garfield, OK	22.2	7.0	32%	$0.6	$0.0	$0.29
Kingfisher, OK	3.4	-3.4	-100%	-$0.28	-$0.05	-$0.14
Logan, OK	20.8	-7.0	-34%	-$0.57	-$0.13	-$0.31

Table 3.13-50:
Estimated Tax Revenues by HVDC Alternative Route and County

County	Total Crossed by Applicant Proposed Route	Largest Net Change (miles)[1]	Percent Change in Miles	Estimated Change Relative to the Applicant Proposed Route		
				Construction Phase Sales and Use Tax Revenues ($ million)		Ad Valorem and Property Tax Revenues ($ million)[2]
				State	County	
Payne, OK	35.7	-8.5	-24%	-$0.69	-$0.12	-$0.34
Lincoln, OK	10.0	9.1	91%	$0.74	$0.16	$0.36
Creek, OK	27.4	-0.2	-1%	-$0.02	$0.00	-$0.01
Okmulgee, OK	27.7	-0.7	-3%	-$0.06	-$0.02	-$0.03
Muskogee, OK	39.5	4.2	11%	$0.34	$0.05	$0.17
Region 4						
Sequoyah, OK	39.9	-1.1	-3%	-$0.09	-$0.03	-$0.04
Crawford, AR	28.4	-3.5	-12%	-$0.41	-$0.06	-$0.07
Franklin, AR	19.8	1.9	10%	$0.22	$0.05	$0.04
Johnson, AR	27.8	1.0	4%	$0.12	$0.02	$0.02
Pope, AR	27.1	-3.1	-11%	-$0.36	-$0.06	-$0.06
Region 5						
Pope, AR	27.1	1.1	4%	$0.13	$0.02	$0.02
Conway, AR	21.6	0.1	0%	$0.01	$0.00	$0.00
Van Buren, AR	13.2	-13.2	-100%	-$1.54	-$0.48	-$0.23
Cleburne, AR	23.5	-23.5	-100%	-$2.75	-$0.69	-$0.39
Faulkner, AR	0.0	21.8	100%	$2.55	$0.20	$0.34
White, AR	17.2	17.6	102%	$2.06	$0.48	$0.59
Jackson, AR	33.7	-0.5	-1%	-$0.06	-$0.02	$0.00
Region 6						
Jackson, AR	33.7	4.4	13%	$0.51	$0.18	$0.00
Poinsett, AR	31.5	14.4	46%	$1.68	$0.32	$0.13
Cross, AR	16.1	-16.1	-100%	-$1.88	-$0.58	$0.00
Region 7						
Mississippi, AR	16.3	12.2	75%	$1.43	$0.44	$0.00
Shelby, TN	5.0	12.9	257%	$1.63	$0.52	$0.58
Tipton, TN	11.4	4.1	36%	$0.52	$0.17	$0.11

1 The miles of transmission line in some counties would be affected under more than one alternative. This column presents the largest change (positive or negative) relative to the Applicant Proposed Route that could occur in each county.

2 Estimated as valorem tax revenues for the Applicant Proposed Route in Oklahoma counties are based on average low and high millage rates (Table 3.13-43). This sensitivity analysis is based on the average of this range of estimates for each county.

3.13.6.3.2.2 Operations and Maintenance Impacts

3.13.6.3.2.2.1 Population, Economic Conditions, Housing, and Community Services

Substituting one of more of the HVDC alternative routes for the corresponding link of the Applicant Proposed Route would not affect estimated operations and maintenance employment for the HVDC and AC transmission lines. Potential impacts to population, economic conditions, housing, and community services from operations and maintenance related to estimated operations and maintenance employment would be the same or very similar to those described above for the Applicant Proposed Route.

3.13.6.3.2.2.2 Property Values

The discussion of property value impacts in Section 3.13.5.2.5 would also apply to the HVDC alternative routes.

3.13.6.3.2.2.3 Tax Revenues

Changes in the projected length of the transmission line by county would result in corresponding changes in the property and ad valorem tax revenues expected to accrue to the affected counties. Net changes in estimated property and ad valorem tax revenues, relative to the Applicant Proposed Route, are identified by county in Table 3.13-50. These changes would be less than $1 million in all cases, ranging from a decrease of about $0.4 million in Cleburne County, Arkansas (Region 5), which would not be crossed by HVDC Alternative Routes 5-B and 5-E, to a relative increase of $0.6 million in Shelby County, Tennessee (Region 7) (Table 3.13-50).

3.13.6.3.2.3 Decommissioning Impacts

3.13.6.3.2.3.1 Population, Economic Conditions, Housing, and Community Services

Decommissioning of the proposed HVDC transmission line would require a labor force approximately equal to that needed for its construction. This would be the case for the Applicant Proposed Route and all the HVDC alternative routes. Impacts to population, economic conditions, housing, and community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.3.2.3.2 Tax Revenues

The general tax implications of decommissioning the HVDC transmission line would be similar to those discussed with respect to the converter stations in Section 3.13.5.2.7 for the Applicant Proposed Route and all the HVDC alternative routes.

3.13.6.4 Best Management Practices

A potential impact related to housing demand exists specifically in Region 1: there is a projected shortage of hotel and motel rooms and RV spaces in this region that would be further exacerbated if the construction schedules for the Oklahoma converter station, AC collection system, and HVDC transmission line were to overlap. The analysis assumes that 25 percent of total hotel and motel units would typically be available. This availability could be further reduced by other outside activities in the ROI such as other construction projects, community-sponsored events, and hunting and other recreational activities.

The Applicant has developed a comprehensive list of EPMs that will help avoid and minimize impacts to socioeconomic resources. A complete list of EPMs for the Project is provided in Appendix F; EPMs that pertain to socioeconomic resources are identified in Section 3.13.6.1. Additionally, the Applicant will prepare and implement a workforce housing strategy that would minimize potential impacts to housing availability. This strategy would consider Project component construction schedules, workforce required, and other outside influences.

3.13.6.5 Unavoidable Adverse Impacts

No unavoidable adverse impacts to socioeconomic resources were identified.

3.13.6.6 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitments of socioeconomic resources were identified. Construction and operation of the Project would involve the use of capital and labor resources. Construction of the Project would also involve the use of temporary housing resources in the Project vicinity. These types of short-term resource use have opportunity costs (resources used for the Project cannot be used for other concurrent projects), but they are not irreversible or irretrievable.

3.13.6.7 Relationship between Local Short-term Uses and Long-term Productivity

Potential short-term impacts to socioeconomic resources are not expected to outweigh the long-term benefits of the Project. In the long term, the Project would be expected to increase economic productivity through the delivery of renewable energy generated in the Oklahoma Panhandle region to load-serving entities in the mid-south and southeast regions of the United States.

3.13.6.8 Impacts from Connected Actions

3.13.6.8.1 Wind Energy Generation

For the purposes of analysis, the Applicant assumed that 90 percent of this capacity would be constructed over a 2-year timeframe leading up to the commercial operation date of the Project, with the remaining 10 percent expected to be built within a year following this date (Clean Line 2014b). Individual wind farms could range in capacity from 50MW to 1,000MW in a single phase; multiple-phased projects are possible. Future nameplate capacities for a single turbine are assumed to range from 1.5MW to 3.5MW (Clean Line 2014b).

The potential socioeconomic impacts of the development of approximately 4,000MW of wind generating capacity in the 12 identified WDZs (Table 3.13-21) are assessed using data derived from the DOE National Renewable Energy Laboratory's Jobs and Economic Development Impacts (JEDI) Wind model (NREL 2014). The JEDI Wind model allows the user to identify potential impacts assuming general wind industry averages.

The following analysis assesses two potential scenarios based on the range of potential capacity for individual wind farms (50MW to 1,000MW per facility). These scenarios recognize that there are labor-related economies of scale associated with larger facilities, during both construction and operation. The two scenarios are as follows: (1) 74 facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; and (2) four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW. The first scenario assumes an average facility (wind farm) consists of sixteen 3.5MW turbines. The second scenario assumes an average facility (wind farm) consists of six hundred fifty 1.5MW turbines. In both scenarios, the proposed generating capacity is assumed to be divided equally between Oklahoma and Texas, with the same total capacity and number of facilities located in the WDZs in each state. Construction is also assumed to spread evenly over the 2 years prior to the transmission line Project's commercial operation date.

3.13.6.8.1.1 Population

3.13.6.8.1.1.1 Construction Impacts

Total annual employment estimates are presented by wind development scenario and stated in Table 3.13-51. Viewed in FTEs, total direct employment under Scenario 1 would be equivalent to 2,080 FTEs. Total direct employment under Scenario 2 would be less than half this total (1,012 FTEs), reflecting the labor economies of scale involved in constructing four 975MW facilities (Scenario 2) versus seventy-four 53MW facilities (Scenario 1). FTEs are employment estimates based on 12 months (2,080 hours) employment. These numbers do not translate into individual workers who may be employed for shorter periods.

The share of the annual construction workforce expected to be hired or contracted locally was estimated using the JEDI Wind model and varies slightly by state and scenario. According to the JEDI Wind model, an estimated 56 percent (Oklahoma) and 57 percent (Texas) of workers under Scenario 1 would be hired locally; 54 percent

(Oklahoma and Texas) of the annual construction workforce would be expected to be hired locally under Scenario 2. The remaining workforce would be expected to temporarily relocate to Region 1 for the duration of their employment, possibly commuting home on weekends, depending on the location of their primary residence.

Very few, if any, of the non-local workers employed during the construction phase of the potential wind facilities would be expected to permanently relocate to the affected areas. For the purposes of analysis, 10 percent of non-local workers temporarily relocating to the area are assumed to be accompanied by family members; the average size of a family that is relocating is assumed to be three, two adults and one school-age child (Clean Line 2013). The estimated annual change in population would be equivalent to approximately 2.l percent of the total Region 1 population in 2012 under Scenario 1 and approximately 1.1 percent under Scenario 2 (Table 3.13-51).

Table 3.13-51:
Estimated Annual Change in Population During Construction by Potential Wind Development Scenario

Workers/Population[1]	Scenario 1[2]			Scenario 2[2]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Workers[3]						
Commute to Job Site Daily[4]	589	589	1,179	276	270	547
Move to the Affected Region alone[5]	414	397	812	215	204	419
Move to the Affected Region with family[5]	46	44	90	24	23	47
Total	1,050	1,031	2,080	515	497	1,012
Population						
2012 Population[6]	28,658	19,322	51,652	28,658	19,322	51,652
Number of People Temporarily Relocating[7]	552	530	1,082	287	272	558
Percent of 2012 Population	1.9%	2.7%	2.1%	1.0%	1.4%	1.1%

1 Data are annual estimates and assume that construction would be spread evenly over 2 years.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 The JEDI Wind model was used to estimate construction workforce requirements by scenario and state. Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
4 The share of the annual construction workforce expected to be hired locally was estimated using the JEDI Wind model and varies slightly by state and scenario.
5 An estimated 90 percent of workers temporarily relocating to the region are assumed to do so alone. The remaining 10 percent are assumed to be accompanied by their families for the purposes of analysis.
6 2012 population totals are as follows:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma (see Table 3.13-4).
7 Number of people temporarily relocating assumes an average family size of 3 (two adults and one school-age child).

3.13.6.8.1.1.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ an estimated total of 140 full-time employees in Oklahoma and 140 full-time employees in Texas under Scenario 1 and 88 full-time employees in each state under Scenario 2, reflecting the labor economies of scale associated with operating a substantially smaller number (4 versus 74) of much larger (975MW versus 53MW) facilities (Table 3.13-52). These estimates were developed using the JEDI Wind model and general wind industry averages. Assuming these employees would all permanently relocate to the area from elsewhere with an average family size of three (two adults and one school-age child), estimated total population increases in Region 1 would be 840 and 530 under Scenarios 1 and 2, respectively, which would be equivalent to 1.6 percent and 1.0 percent of the total population in Region 1 in 2012 (Table 3.13-52).

Table 3.13-52:
Estimated Annual Change in Population During Operations and Maintenance by Potential Wind Development Scenario

Workers/Population[1]	Scenario 1[2]			Scenario 2[2]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
2012 Population[3]	28,658	19,322	51,652	28,658	19,322	51,652
Number of Workers[4]	140	140	280	88	88	177
Number of People Permanently Relocating[5]	420	420	840	265	265	530
Percent of 2012 Population	1.5%	2.2%	1.6%	0.9%	1.4%	1.0%

1 Data are annual estimates and assumed to continue for the operating lives of the potential facilities.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 2012 population totals are as follows:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma (see Table 3.13-4).
4 The JEDI Wind model was used to estimate annual operations and maintenance workforce requirements by scenario and state. Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
5 Number of people permanently relocating assumes that all the onsite workers would relocate from elsewhere and represent an average family size of three (two adults and one school-age child).

3.13.6.8.1.1.3 Decommissioning Impacts

Decommissioning of the potential wind generation facilities would require a labor force approximately equal to that needed for their construction. Impacts to population from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.8.1.2 Economic Conditions

3.13.6.8.1.2.1 Construction Impacts

Construction of the two potential wind development scenarios would result in a temporary increase in employment and earnings in the surrounding area. Annual estimates are presented by scenario and state in Table 3.13-53. Construction would support an estimated total (direct, indirect, and induced) of 9,910 jobs in Region 1 under Scenario 1 and 8,762 jobs under Scenario 2. Construction would also support estimated total (direct, indirect, and induced) earnings of $494 million and $435 million under Scenarios 1 and 2, respectively (Table 3.13-53). These annual impacts would occur each year for 2 years leading up to the commercial operation date of the Project.

Table 3.13-53:
Total Annual Economic Impacts During Construction by Potential Wind Development Scenario

Impacts[1]	Scenario 1[2]			Scenario 2[2]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Employment (Jobs)[3]						
Direct Impact	1,050	1,031	2,080	515	497	1,012
Indirect and Induced Impacts	3,986	3,843	7,830	3,962	3,789	7,750
Total Impacts	5,036	4,874	9,910	4,477	4,285	8,762
Annual Earnings ($ million)[4]						
Direct Impact	$48.34	$63.24	$111.58	$24.83	$31.71	$56.53
Indirect and Induced Impacts	$170.72	$211.61	$382.33	$169.60	$208.60	$378.20
Total Impacts	$219.05	$274.85	$493.90	$194.43	$240.31	$434.73

1 The JEDI Wind model was used to estimate direct, indirect, and induced impacts. Indirect impacts during construction are identified in the model as turbine and supply chain impacts. Data are annual estimates and assume that construction would be spread evenly over 2 years. Indirect and induced impacts are estimated at the state level.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
4 Annual earnings are expressed in millions of dollars in year 2014 dollars.

3.13.6.8.1.2.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ an estimated total of 140 full-time employees in Oklahoma and 140 full-time employees in Texas under Scenario 1 and 88 full-time employees in each state under Scenario 2 (Table 3.13-54).

Operations and maintenance would support an estimated total (direct, indirect, and induced) of 798 jobs under Scenario 1 and 665 jobs under Scenario 2. Operations and maintenance would also support estimated total (direct, indirect, and induced) earnings of $41.2 million and $32.9 million under Scenarios 1 and 2, respectively (Table 3.13-54). These annual impacts would occur each year for the operating life of the potential facilities.

Table 3.13-54:
Total Annual Economic Impacts During Operations and Maintenance by Potential Wind Development Scenario

Impacts[1]	Scenario 1[2] Oklahoma	Scenario 1[2] Texas	Scenario 1[2] Region 1 Total	Scenario 2[2] Oklahoma	Scenario 2[2] Texas	Scenario 2[2] Region 1 Total
Employment (Jobs)[3]						
Direct Impact	140	140	280	88	88	177
Indirect and Induced Impacts	237	281	518	224	264	488
Total Impacts	377	421	798	312	352	665
Annual Earnings ($ million)[4]						
Direct Impact	$7.12	$9.56	$16.68	$4.17	$5.60	$9.77
Indirect and Induced Impacts	$9.87	$14.65	$24.52	$9.41	$13.72	$23.13
Total Impacts	$17.00	$24.21	$41.20	$13.58	$19.32	$32.90

1 The JEDI Wind model was used to estimate direct, indirect, and induced impacts. Indirect impacts during construction are identified in the model as local revenue and supply chain impacts. Data are annual estimates and assumed to continue for the operating lives of the potential facilities. Indirect and induced impacts are estimated at the state level.
2 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.
3 Jobs are FTEs for a period of one year (1 FTE = 2,080 hours).
4 Annual earnings are expressed in millions of dollars in year 2014 dollars.

3.13.6.8.1.2.3 Decommissioning Impacts

Decommissioning of the HVDC transmission line would require a labor force approximately equal to that needed for its construction. Local expenditures on materials and supplies and payments to workers would likely be similar, resulting in broadly similar economic impacts to those from construction.

3.13.6.8.1.3 Agriculture

Agriculture is the primary existing land use in the 12 WDZs. An estimated 3 to 5 percent of the land within the boundaries of each potential wind energy facility is expected to be affected during construction, with 1 percent or less expected to be affected during the operations and maintenance phase of each facility. Assuming full build-out, 20 to 30 percent of the area within the WDZs would involve an estimated total of 6,492 to 16,230 acres of primarily agricultural land would be affected during construction, with 2,164 to 3,246 acres affected during operations and maintenance (see Section 3.2). This potential disturbance represents a very small share of the 5.7 million acres of land in farms in Region 1 (Table 3.13-9) and is unlikely to noticeably affect overall agricultural production and employment in the affected counties.

In cases where turbines are located on agricultural land, land owners typically receive lease payments. Wind lease agreements usually include provisions to minimize construction-related losses, including minimizing soil compaction and revegetating temporary work areas. In addition, these types of agreement typically stipulate compensation for landowners for other potential losses, such as damage to or loss of crops, gates, fences, landscaping and trees, irrigation, and livestock.

3.13.6.8.1.4 Housing

3.13.6.8.1.4.1 Construction Impacts

Using the same assumptions employed in the above transmission line Project analysis, an estimated 45 percent of the workers temporarily relocating during construction are expected to require motel or hotel rooms, with the remaining non-local workers expected to require rental housing (apartments, houses, or mobile homes) (20 percent), or provide their own housing in the form of RVs or pop-up trailers (35 percent). Projected average annual housing demand based on the number of FTE workers for the anticipated 2-year construction period is compared with estimated supply in Table 3.13-55.

This comparison indicates that temporary housing demand under Scenario 1 (74, 53MW facilities built over 2 years) would be more than double (232 percent) of the supply of rental housing in the three Texas counties. Demand under Scenario 1 would also exceed the estimated supply of available hotel and motel rooms in the counties in both states and Region 1 as a whole. Demand for RV spaces would exceed the total identified spaces in the three Oklahoma counties and Region 1 as a whole, and be almost equal to the number of identified spaces in the three Texas counties (Table 3.13-55).

Projected housing demand would be lower under Scenario 2 (four 975MW facilities) due to labor economies of scale. This scenario represents the low end of the range of potential effects on housing; Scenario 1 represents the high end of this range. Under this scenario, demand would exceed supply for rental housing in the three Texas counties. Demand would also exceed the estimated supply of available hotel and motel rooms in the three Texas counties, as well as the total number of identified RV spaces in the three Oklahoma counties (Table 3.13-55).

Table 3.13-55:
Estimated Construction-Related Housing Demand by Potential Wind Development Scenario

Housing/Geographic Area	Scenario 1[1]			Scenario 2[1]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Projected Non-Local Employment[2]	460	442	902	239	226	465
Projected Peak Housing Demand						
Rental Housing	92	88	180	48	45	93
Hotel and Motel Rooms	207	199	406	108	102	209
RV Spaces	161	155	316	84	79	163
Estimated Available Housing Units[3]						
Rental Housing	279	38	370	279	38	370
Hotel and Motel Rooms[4]	194	76	273	194	76	273
RV Spaces	48	161	235	48	161	235
Projected Demand as a Share of Existing Resources						
Rental Housing	33%	232%	49%	17%	119%	25%
Hotel and Motel Rooms	107%	262%	149%	55%	134%	77%
RV Spaces	336%	96%	134%	174%	49%	69%

1 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.

2 The JEDI Wind model was used to estimate construction workforce requirements by scenario and state. Jobs are FTEs for a period of one year (1 FTE = 2,080 hours). According to the JEDI Wind model analysis, an estimated 44 percent (Oklahoma) and 43 percent (Texas) of workers under Scenario 1 would be hired locally, with 46 percent (Oklahoma and Texas) of the annual construction workforce expected to be hired locally under Scenario 2.

3 Estimated housing unit totals are for the following counties:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma (see Table 3.13-10).

4 Assumes an average occupancy rate of 75 percent for the purposes of analysis, with 25 percent of total units assumed to be available.

3.13.6.8.1.4.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ an estimated total of 140 full-time employees in Oklahoma and 140 full-time employees in Texas under Scenario 1, and 88 full-time employees in each state under Scenario 2. If all these employees permanently relocated to the area, a corresponding demand for permanent housing would be created. This potential demand is compared with housing data in Table 3.13-56. In the short-term, workers relocating would likely stay in hotels or motels while looking for a more permanent residence to rent or purchase.

Economic development organizations in the Oklahoma Panhandle region have identified a potential shortage in permanent housing in and around the city of Guymon in Texas County, with these problems expected to be further exacerbated by this type of wind energy development (Fleming 2013). Estimated demand under Scenario 1 in the three Oklahoma counties would be equivalent to 31 percent of the housing units available for rent or sale in 2012 (140 versus 450). Demand in the three Texas counties would be almost 1.8 times the number of housing units available for rent or sale under Scenario 1 (140 versus 79), and 1.1 times under Scenario 2 (88 versus 79) (Table 3.13-56). This imbalance may be partially offset by some of the housing units currently identified as "other vacant" coming on the market for rent or sale. "Other vacant" housing units comprised 59 percent of the vacant housing in the three Texas counties in 2012.

Table 3.13-56:
Estimated Housing Demand by Potential Wind Development Scenario under Operations and Maintenance

Housing/Geographic Area[2]	Scenario 1[1]			Scenario 2[1]		
	Oklahoma	Texas	Region 1 Total	Oklahoma	Texas	Region 1 Total
Number of Households Permanently Relocating[3]	140	140	280	88	88	177
Vacant Housing Units						
For Rent or Sale	450	79	597	450	79	597
Rented or Sold, Not Occupied	242	113	365	242	113	365
Seasonal, Recreational, or Occasional use	158	192	409	158	192	409
Other Vacant4	1,349	544	2,153	1,349	544	2,153
Total	2,199	928	3,524	2,199	928	3,524

1 Scenario 1 consists of 74 wind generation facilities with a nameplate capacity of 53MW, for a total capacity of 3,885MW; Scenario 2 consists of four facilities with a nameplate capacity of 975MW, for a total capacity of 3,900MW.

2 Estimated housing unit totals are for the following counties:
Oklahoma = Cimarron, Texas, and Beaver counties
Texas = Hansford, Ochiltree, and Sherman counties
Region 1 Total = The above six counties plus Harper County, Oklahoma

3 Number of households relocating is based on estimated total annual employment and assumes that all workers would permanently relocate to the area from elsewhere.

4 According to the U.S. Census Bureau, a housing unit is classified as "other vacant" when it is unoccupied and does not fit into one of the other categories identified in the above table. Common reasons a housing unit is labeled as "other vacant" are that nobody lives in the unit and the owner is making repairs or renovating, does not want to rent or sell, or the unit is being held for settlement of an estate or in foreclosure (Kresin 2013).

3.13.6.8.1.4.3 Decommissioning Impacts

Decommissioning of the wind facilities would require a labor force approximately equal to that needed for their construction. Impacts to housing from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.8.1.5 Community Services

3.13.6.8.1.5.1 Construction Impacts

Increased demands for local services that would likely occur from wind facility construction workers and family members temporarily relocating to the affected areas would be short term. The estimated number of workers and family members expected to temporarily relocate to Region 1 during construction ranges from 558 (Scenario 2) to 1,082 (Scenario 1) (Table 3.13-51). This estimated increase in population would be equivalent to approximately 1.1 percent to 2.1 percent of total Region 1 population in 2012 (Table 3.13-51). The temporary addition of these workers and family members to local communities is not expected to affect the levels of service provided by existing law and fire protection personnel.

Medical facilities located in Region 1 are identified in Table 3.3-12 and discussed with respect to the AC collection system routes in Section 3.13.2.4.2. The temporary relocation of workers and family members to the counties in the region is not expected to affect existing levels of health care and medical services.

The estimated number of children expected to temporarily relocate to Region 1 during peak construction ranges from about 47 (Scenario 2) to 90 (Scenario 1) (Table 3.13-51). These children would likely be located in a number of different school districts throughout Region 1 and would not be expected to affect existing average student/teacher ratios (Table 3.13-13).

Spending by relocating workers and their families would likely generate economic benefits for community commercial and retail services, as would be the case with other local construction-related expenditures.

3.13.6.8.1.5.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would employ between 177 (Scenario 2) and 280 (Scenario 1) workers. If these workers and their families were all to relocate from elsewhere, the estimated increase in population would be equivalent to approximately 1.0 percent to 1.6 percent of total Region 1 population in 2012 (Table 3.13-52). The permanent addition of these workers and family members would not be expected to affect the provision of community services in the affected areas.

3.13.6.8.1.5.3 Decommissioning Impacts

Decommissioning of the transmission lines would require a labor force approximately equal to that needed for their construction. Impacts to community services from decommissioning are, therefore, expected to be similar to those from construction.

3.13.6.8.1.6 Tax Revenues

3.13.6.8.1.6.1 Construction Impacts

Construction of the potential wind facilities would generate sales, use, and lodging tax during the construction period. All equipment and material costs are assumed for the purposes of analysis to be subject to sales and use tax. Wind facility equipment would include turbines, blades, and towers. Materials would include transformers, electrical equipment, and construction materials (concrete, rebar, and construction equipment). Estimated equipment and material costs are approximately $95 million for a single 50MW wind facility and $1.79 billion for a single 1,000MW facility. These costs were estimated using the JEDI Wind model and general wind energy averages. The use of these averages results in total estimated equipment and material costs of $6,981 million and $7,159 million for Scenarios 1 and 2, respectively.

State sales and use tax rates are 4.5 percent in Oklahoma and 6.25 percent in Texas (Tables 3.13-15 and 3.13-14, respectively). Estimated state sales and use tax revenues would range from $158 million to $161 million in Oklahoma and from $217 million to $223 million in Texas, with the higher end of the range in each case estimated for Scenario 2.

None of the potentially affected Texas counties levy local sales and use tax. In the three Oklahoma counties, local county sales and use tax rates are either 1 percent (Texas County) or 2 percent (Cimarron and Beaver counties) (Table 3.13-15). Based on these rates, estimated county sales and use tax revenues per facility would range from $0.9 million to $1.9 million for a 50MW facility and from $17.9 million to $35.7 million for a 1,000MW facility.

3.13.6.8.1.6.2 Operations and Maintenance Impacts

Operations and maintenance of the potential wind facilities would generate annual property or ad valorem tax revenues in the counties where they would be located. Estimated installed costs are approximately $105 million for a single 50MW wind facility and $1.95 billion for a single 1,000MW facility. These costs were estimated using the JEDI Wind model and general wind energy averages. The use of these averages results in total estimated installed costs of $7,774 million and $7,798 million for Scenarios 1 and 2, respectively.

Millage rates for the potentially affected Oklahoma counties range from 52.19 to 80.73 (Table 3.13-19). Adjusting the range of estimated installed costs for a single wind facility by the state assessment ratio (the state share of assessed value subject to taxation) of 22.85, the application of these millage rates would result in ad valorem tax revenues ranging from $1.9 million (for a 50MW facility in Beaver County) to $36 million (for a 1,000MW facility in Texas County).

Average millage rates (expressed per $1,000 of assessed value) in the three potentially affected Texas counties range from 4.131 (Hansford County) to 4.392 (Sherman County) (Table 3.13-18). Using a simplified cost approach, property tax revenues for a single wind facility could range from $4.3 million (for a 50MW facility in Hansford County) to $85.6 million (for a 1,000MW facility in Sherman County).

3.13.6.8.1.6.3 Decommissioning Impacts

The general tax implications of decommissioning the potential wind generation facilities would be similar to those discussed with respect to the converter stations, above (see Section 3.13.5.2.7.1).

3.13.6.8.2 Optima Substation

Employment during construction of the substation would follow a similar bell-shaped pattern as construction of the proposed converter stations (see Figure 3.13-2) but would likely involve fewer workers. Impacts would be similar to those discussed for the Oklahoma converter station, but smaller. Some workers would likely temporarily relocate to the Texas County area for the duration of their employment. Adequate temporary housing likely exists to accommodate this demand, but a potential shortage in temporary housing could occur if construction of the future Optima Substation were to coincide with construction of the Oklahoma converter station, AC collection system routes, or HVDC transmission line in this area. The Applicant proposes to prepare and implement a workforce housing strategy for the Project designed to minimize potential impacts to housing availability.

3.13.6.8.3 TVA Upgrades

A precise ROI has not been identified for the TVA upgrades. Where possible, general impacts associated with the required TVA upgrades are discussed below.

The required TVA upgrades could result in potential impacts to population, economic conditions, housing, property values, community services, and tax revenues. A short-term increase in the influx of temporary workers and increased demand for temporary housing resources and goods and services would be expected during construction activities, particularly construction of the new electric transmission line. The temporary relocation of construction workers to the affected areas could create increased demand for community services such as education, medical facilities, municipal services, police, and fire in addition to retail services. These potential effects would be short term and temporary. New permanent employment associated with the operation of the upgraded facilities would not likely have a noticeable effect on existing short- or long-term population trends or demand for housing and goods and services.

Local expenditures, employment, and construction-related earnings would have a positive impact on the local economy and employment for the duration of construction. Construction of the required TVA upgrades would generate sales and use tax revenues through expenditures on construction supplies and equipment. Long-term economic impacts from the required TVA upgrades would be primarily associated with operation and maintenance-related expenditures for materials and supplies and property tax revenues. The new 500 kV transmission line would be a new facility and would, therefore, result in a larger net increase in property tax revenues than the upgrades to already existing infrastructure. Overall, economic impacts would be expected to be small.

3.13.6.9 Impacts Associated with the No Action Alternative

Under the No Action Alternative, DOE assumes for analytical purposes that the Project would not be constructed. There would be no Project-related impacts to socioeconomics.

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