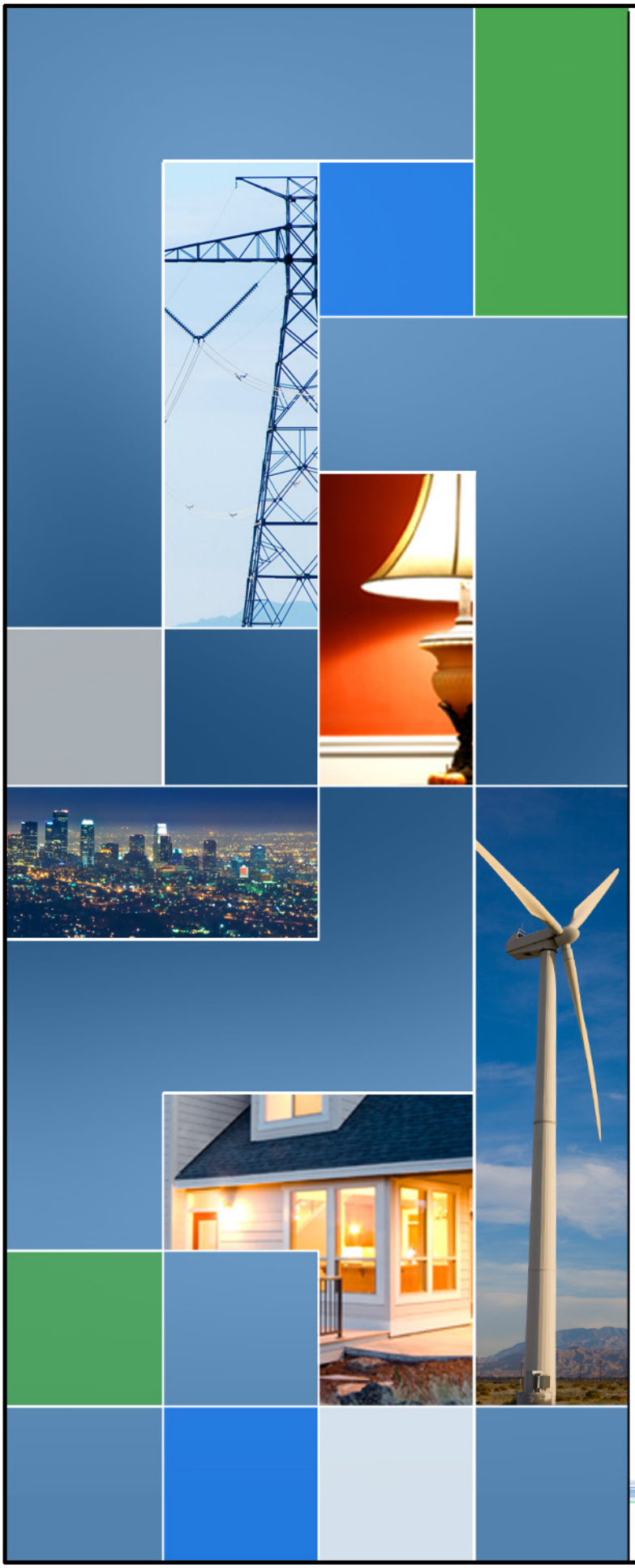

TransWest Express Transmission Project

Preliminary Plan of Development, Amended from July 2010

Submitted by

TRANSWEST EXPRESS LLC

Submitted to

NATIONAL SYSTEM OF PUBLIC LANDS

Wyoming State Office

Western AREA POWER ADMINISTRATION

November 2014

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
±	plus or minus
AC	alternating current
AC/DC	alternating current/direct current
ACC	Arizona Corporation Commission
ACSR	aluminum conductor steel reinforced
ACSR/TW	Aluminum Conductor Steel Reinforced/Trapezoidal Wire
AEG	Anschutz Entertainment Group
Anschutz	Anschutz Company
ANSI	American National Standards Institute
APLIC	Avian Power Line Interaction Committee
Applicant	TransWest Express LLC, also TransWest
ATV	all terrain vehicles
BA	Biological Assessment
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practices
BO	Biological Opinion
CCR	Code of Colorado Regulations
CDOT	Colorado Department of Transportation
CEQ	Council on Environmental Quality
CFR Part	Code of Federal Regulations, and use Part before the number (e.g., 20 CFR Part 4)
CIC	Compliance Inspection Contractor
COM	Construction, Operation, and Maintenance
CRS	Colorado Revised Statutes
CWA	Clean Water Act
DC	direct current
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DOE	U.S. Department of Energy
DOT	Department of Transportation
E.O.	Executive Order
ECMP	Environmental Compliance and Monitoring Plan
EHV	extra high voltage
EIS	Environmental Impact Statement
EMF	electromagnetic field
EMM	Environmental Mitigation Measure
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FLPMA	Federal Land Policy and Management Act of 1976
GHG	Greenhouse Gas
GIS	Geographic Information System
GWh/yr	gigawatt-hours per year
HVDC	high voltage direct current

IEEE	Institute of Electrical and Electronics Engineers
IPP	Intermountain Power Plant
IRA	Inventoried Roadless Areas
IVM	integrative vegetation management
kV	kilovolt
LADWP	Los Angeles Department of Water and Power
LWCF	Land and Water Conservation Fund Act
MW	megawatt
NAC	Nevada Administrative Code
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act of 1969
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NHPA	National Historic Preservation Act of 1966
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park System
NREL	National Renewable Energy Lab
NRS	Nevada Revised Statutes
NTP	Notice to Proceed
OPGW	optical ground wire
OSHA	Occupational Safety and Health Administration
OSLI	Office of State Lands and Investments
PA	Programmatic Agreement
PI	Points of Intersection/Inflection
PL	Public Land
POD	Plan of Development
Project	TransWest Express Transmission Project, also TWE Project
PSC	Public Service Commission
PUC	Public Utility Commission
REC	renewable energy credit
Reclamation	U.S. Bureau of Reclamation
RES	Renewable Energy Standard
ROD	Record of Decision
ROW	right-of-way
RPS	Renewable Portfolio Standards
SB	Senate Bill
SCADA	Supervisory Control and Data Acquisition
SHPO	State Historic Preservation Office
SPCC	Spill Prevention, Containment and Countermeasure
STS	Southern Transmission System
SUA	Special Use Authorization
SWPPP	Stormwater Pollution Prevention Plan
TAC	The Anschutz Corporation
TIP	Transmission Infrastructure Program
TransWest	TransWest Express LLC, also Applicant
TWE Project	TransWest Express Transmission Project, also Project
U.S.C. §	U.S. Code and section number symbol
UCA	Utah Code Annotated
UDOT	Utah Department of Transportation

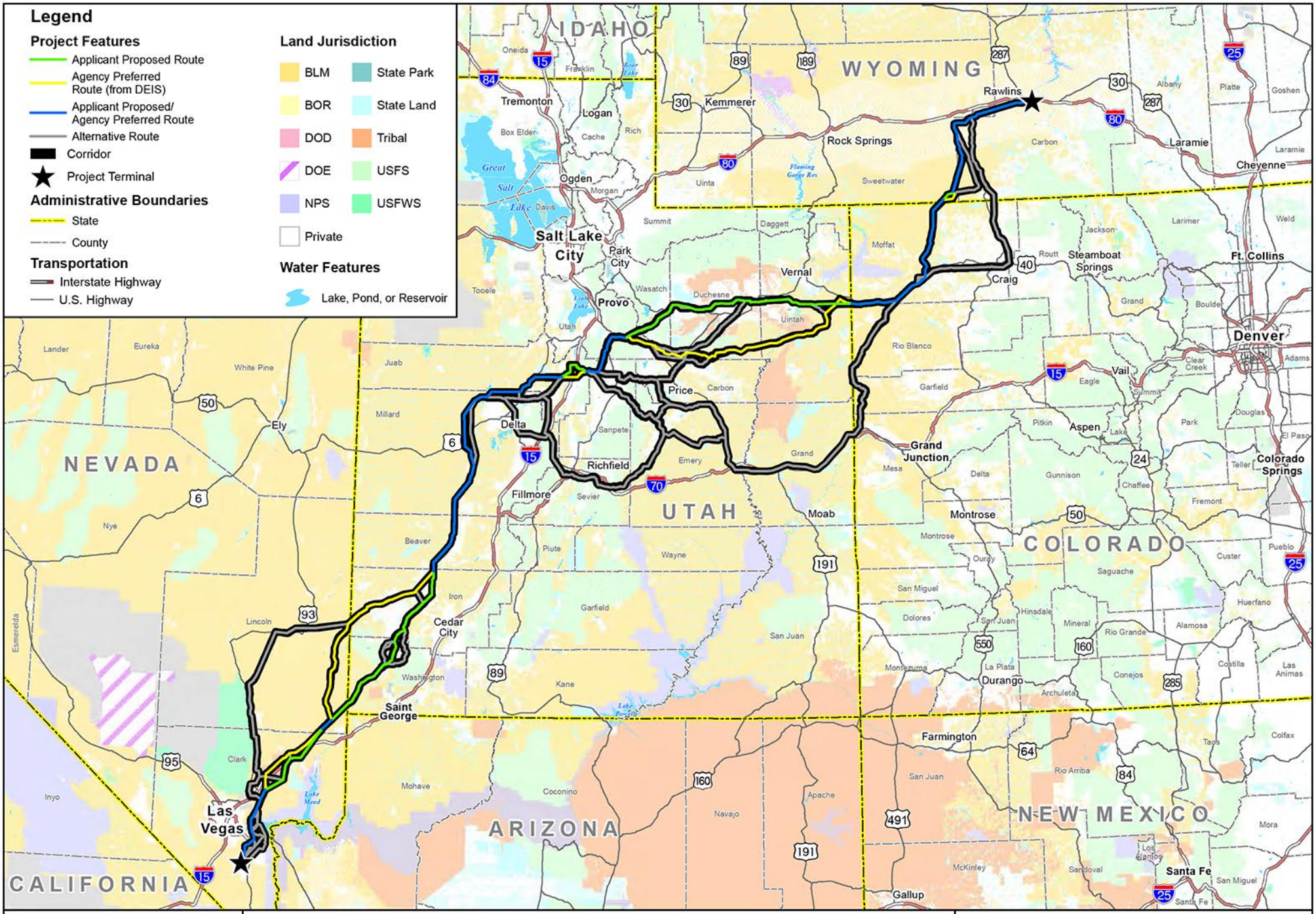
UHF	ultra-high frequency
USACE	U.S. Army Corps of Engineers
USDA	US Department of Agriculture
USDI	U.S. Department of Interior
USDOT	U.S. Department of Transportation
USFS	United States Forest Service
USFWS	U.S. Fish and Wildlife Service
VHF	very high frequency
WECC	Western Electricity Coordinating Council
Western	Western Area Power Administration
WGA	Western Governors Association
WGFD	Wyoming Game and Fish Department
WSO	work stoppage order
WWEC	West-wide Energy Corridor

1.0 INTRODUCTION

1.1 Project Background

TransWest Express LLC (TransWest or Applicant) proposes to construct, operate and maintain the TransWest Express Transmission Project (TWE Project or Project). The TWE Project is an extra-high voltage (EHV) direct current (DC) transmission system extending from south-central Wyoming to southern Nevada. The TWE Project begins at a northern terminal near Sinclair, Wyoming and terminates at a southern terminal at the Marketplace Hub in the Eldorado Valley near Boulder City, Nevada (Map Exhibit 1). At each of the terminals, there will be an alternating current/direct current (AC/DC) converter station designed to convert the DC current carried by the TWE Project to AC current to be carried on the western United States AC electrical grid (the northern and southern terminals). The TWE Project is planned to interconnect into the 230 kV AC system in Wyoming and the Eldorado Substation, the McCullough Switching Station, the Marketplace Substation and the Mead Substation in Nevada. Western Area Power Administration (Western), a federal power marketing administration within the United Stated Department of Energy (DOE), has partnered with TransWest in the development of the TWE Project.

Because it is necessary for the TWE Project to cross federal lands, a right-of-way (ROW) application was filed with the Department of the Interior's (USDI) Bureau of Land Management (BLM) in 2007. The application was amended by TransWest in 2008 and again in 2009, 2010, and 2014. To comply with the National Environmental Policy Act of 1969 (NEPA), the BLM and Western are preparing an Environmental Impact Statement (EIS). Public scoping was conducted in 2011. In July 2013, the BLM and Western published the Draft Environmental Impact Statement (DEIS) for the TWE Project. The DEIS analyzed approximately 2,600 miles of Alternatives.



Map Exhibit 1
DEIS Routes, Regional Vicinity
TransWest Express Transmission Project | May 2014

POWER ENGINEERS

TRANSWEST EXPRESS LLC

1.2 Project Overview

The TWE Project will entail the construction, operation and maintenance of a ±600 kilovolt (kV) DC transmission line and two AC/DC converter stations - a Northern AC/DC Converter Station (Northern Terminal) to be located near Sinclair, Wyoming and a Southern AC/DC Converter Station (Southern Terminal) to be located at the Marketplace Hub in the Eldorado Valley, approximately 15 miles south of Boulder City, Clark County, Nevada. The ±600 kV DC transmission line will provide for a potential interconnection with the Intermountain Power Plant (IPP) transmission system in Millard County, Utah as well. The preliminary cost estimate for the construction of the TWE Project is $3.0 billion in 2014 dollars. This estimate is based on the Applicant Proposed Alternative and will need to be updated to reflect the Alternative ultimately selected through the NEPA compliance process and upon completion of final engineering design studies. Preliminary cost estimates for operation and maintenance of the TWE Project are on the order of $25 million per year. The life of the TWE Project is anticipated to be 50 years. Project facilities will be maintained to ensure the safe, reliable operation of the system.

The proposed TWE Project consists of the following components:

- A ±600 kV DC transmission line between south-central Wyoming and southern Nevada. A 250-foot-wide ROW will generally be required for the ±600 kV DC transmission line.

- Two terminals for the AC/DC converter stations and related substations, to be located at either end of the ±600 kV DC transmission line. The proposed TWE Project includes the Northern Terminal near Sinclair, Wyoming, and the Southern Terminal south of Boulder City, Nevada near the Marketplace Hub in the Eldorado Valley, with interconnections to the existing and planned regional alternating current (AC) transmission grid.

- Two independent communications systems, including a dedicated fiber optic network, for command and control of the transmission system. The fiber optic network will require regeneration sites at periodic distances along the ±600 kV DC transmission line. In most cases, the regeneration sites will be located within the transmission line ROW. The second communication system will use existing private networks. Microwave antennas may be located at the terminals to connect into these private systems.

- Two ground electrode systems, to be located within approximately 100 miles of the terminals. A low voltage overhead line will be needed to connect the ground electrode systems and AC/DC converter stations.

- Access roads to the TWE Project facilities. The TWE Project's proposed Access Road Plan entails making improvements to existing roads, constructing new roads, and using overland access methods for the construction, operation, and maintenance of the TWE Project. Existing roads will be used to the extent feasible

- Temporary work areas will be required during construction of the TWE Project including terminals; ground electrode systems; structures; staging areas; material storage areas; fly yards; pulling, tensioning, and splicing sites; communication and regeneration sites; and batch plants.

1.3 Purpose of the Plan of Development (POD)

A Plan of Development (POD) documents a federal ROW applicant's construction, operation, rehabilitation, and environmental protection plan. See 43 Code of Federal Regulations (CFR) Part 2804.25. The POD is a dynamic document updated as a project progresses through the NEPA review and

analysis process. The purpose of this version of the POD is to support the analysis and publication of the BLM's Final Environmental Impact Statement (FEIS). An updated POD will be issued with the federal agencies Record of Decision (ROD) for the Project to include additional data such as biological assessments and evaluations and to support additional engineering, micro-siting, contracting and permitting of the Agency Preferred Alternative included in the ROD. Appendix AB provides an example of the mapping to be provided in the ROD POD which will show the initial layout of access roads, temporary work areas, and constraints (e.g., special status species habitat) based on the selected Agency Preferred Alternative. .An updated and final POD will be issued with the Project Notice to Proceed (NTP). The NTP POD will include the final project description; final engineered alignment; access road layouts; construction plans; construction practices and procedures; processes and procedures for complying with the ROD and Environmental Compliance and Monitoring Plan (Appendix G); and will be based on field verified segment-specific construction plans including results of surveys. The TWE Project POD development approach is described in detail in the Project Design and Implementation Plan of Development Refinement Process provided in Appendix Y.

The POD for the TWE Project serves many purposes. For the Project, the POD will:

- Provide the Project description and technical information necessary for the federal agencies to conduct required environmental reviews of the Project, including compliance with the NEPA.
- Identify TransWest's construction plans and specifications, including federal agency stipulations, conditions of approval, environmental requirements and best management practices (BMPs).
- Support the federal agencies ROD for the Project.
- Meet all federal land management agency requirements for issuance of ROW grants or special use authorizations.
- Provide the basis for the federal land management agencies to issue NTPs for construction, operation, and maintenance of the Project. Multiple NTPs are anticipated, each to be issued on a construction segment basis.
- Balance Project design development with the extent of available siting opportunities and constraints data throughout the federal approval process.

The POD and its appendices will serve as the TWE Project's reference for new or amended permits, approvals, clearances and plans that may be issued during construction.

The USDI defines mitigation to encompass the full suite of activities to avoid, minimize, and compensate for adverse impacts to particular resources or values (Clement et al. 2014). Twenty-four plans that detail TransWest's commitment to mitigate adverse impacts resulting from construction, operation, and maintenance of the TWE Project comprise Appendices A through X of the POD. Table 1 indicates the status of these environmental protection plans for the current and subsequent phases of the POD.

TABLE 1 STATUS OF ENVIRONMENTAL PROTECTION PLANS IN THE POD

PLAN	APPENDIX DESIGNATION	POD STATUS		
		FEIS	ROD	NTP
Access Road Siting and Management Plan	A	Framework plan	Update based on Agency Preferred Alternative: provide mapping of initial access road	Complete with final layout of access roads and temporary work

PLAN	APPENDIX DESIGNATION	POD STATUS		
		FEIS	ROD	NTP
			layout and initial layout of temporary work areas.	areas defined in Section 5.2.2.
Avian Protection Plan	B	Framework plan	Update based on the selected Agency Preferred Alternative and relevant mitigation measures to ensure regulatory compliance.	Complete based on final design.
Blasting Plan	C	Framework plan	Update based on the selected Agency Preferred Alternative; proposed methods to achieve the desired excavations using individual shot plants (where the explosives are planted).	Complete with updated information to include mapping of explosive storage locations and areas where blasting will occur, including identification of blasting within 0.25 mile of a known sensitive resource; as well as blasting in the vicinity of pipelines, and wells and springs that may be impacted.
Cultural Resources Protection and Management Plan	D	Framework plan	Update with information contained within the executed Programmatic Agreement (PA).	Complete with updated information based on completion of cultural inventory studies, mitigation plans, and monitoring plans.
Dust Control and Air Quality Plan	E	Framework plan	Update relevant mitigation measures to ensure regulation compliance.	Complete
Emergency Preparedness and Response Plan	F	Framework plan	Update with current available information.	Complete with updated contact information
Environmental Compliance and Monitoring Plan	G	Framework plan	Include more specifically defined roles, responsibilities and procedures.	Complete with fully defined roles, responsibilities and procedures.
Fire Protection Plan	H	Framework plan	Update restricted operations section, complete notifications section, update relevant mitigation measures to ensure regulation compliance and safety.	Complete
Flagging, Fencing and Signage Plan	I	Framework plan	Update flagging, fencing and signage scheme (table) based on selected Agency Preferred Alternative.	Complete with final flagging, fencing and signage scheme.
Geotechnical Plan	J	Framework plan	Update based on selected Agency Preferred Alternative.	Complete
Greater-Sage Grouse Habitat	K	Framework plan	Updated based on selected	Complete

PLAN	APPENDIX DESIGNATION	POD STATUS		
		FEIS	ROD	NTP
Equivalency Analysis, Mitigation and Monitoring Plan		based on FEIS Agency Preferred Alternative	Agency Preferred Alternative.	
Hazardous Materials Management Plan	L	Framework plan	Include relevant mitigation measures to ensure regulation compliance and safety.	Complete
Health and Safety Plan	M	Framework plan	Include relevant mitigation measures to ensure regulation compliance and safety.	Complete
Noxious Weed Management Plan	N	Framework plan	Update plan based on selected Agency Preferred Alternative including access roads and temporary work areas; and complete agency contact information and weed GIS data.	Complete based on the final design and results of noxious weed preconstruction survey.
Operations and Maintenance Plan	O	Framework plan	Update environmental mitigation measures based on selected Agency Preferred Alternative. Complete seasonal wildlife restrictions table.	Complete
Paleontological Resources Management and Mitigation Plan	P	Framework plan	Update plan based on selected Agency Preferred Alternative. Include relevant mitigation measures to ensure resource protection.	Complete
Reclamation Plan	Q	Framework plan	Update plan based on selected Agency Preferred Alternative.	Complete based on final design.
ROW Preparation and Vegetation Management Plan	R	Framework plan	Update plan based on selected Agency Preferred Alternative including access roads and temporary work areas; and complete agency contact information and seed mix requirements for each relevant BLM and Forest Service field office.	Complete based on final design.
Spill Prevention and Response Plan	S	Framework plan	Include relevant mitigation measures to ensure regulation compliance and safety.	Complete with appropriate emergency contacts.
Stormwater Pollution Prevention Plan	T	Framework plan	Include relevant mitigation measures to ensure compliance and for incorporation into Stormwater Pollution Prevention Plans (SWPPPs).	Complete Plan will be the same, but individual SWPPPs will be completed for each state.
Traffic and Transportation	U	Framework plan	Update plan based on	Complete

PLAN	APPENDIX DESIGNATION	POD STATUS		
		FEIS	ROD	NTP
Management Plan			selected Agency Preferred Alternative: use of public roads and highways.	
Visual Resources Management Plan	V	Framework plan	Update plan based on selected Agency Preferred Alternative: more specific visual resource mitigation.	Complete
Water Resources Protection Plan	W	Framework plan	Update plan based on selected Agency Preferred Alternative: complete 303(d) list of impaired waters and preliminary estimate of impacts to waters of the U.S.	Complete with identified impacts and a mitigation plan (if necessary) based on field surveys.
Wildlife and Plant Conservation Measures Plan	X	Framework plan	Update plan based on selected Agency Preferred Alternative: define specific species lists, habitats, draft mitigation, and preconstruction requirements.	Complete with identified impacts and a mitigation plan (if necessary) based on field surveys.

1.4 Organization of the FEIS POD

The FEIS POD describes the TWE Project according to the following topics:

Section 2 describes the TWE Project purpose and need including project objectives and needs, North American Electric Reliability Corporation (NERC) standards and Western Electricity Coordinating Council (WECC) criteria, and renewable energy and transmission.

Section 3 describes roles and responsibilities of each major Project entity including TransWest, Western, BLM, the United States Forest Service (USFS), and other Federal agencies, compliance inspection contractor, and construction contractor(s).

Section 4 provides a description of TWE Project components which includes a description of all proposed facilities and temporary and permanent land disturbance estimates.

Section 5 describes the construction practices that would be performed for the TWE Project, including standard construction activities, schedules and equipment/manpower requirements, and special construction practices which will be used in selective or sensitive environments.

Section 6 discusses operation and maintenance practices for the TWE Project, including routine maintenance and vegetation management of the transmission line ROWs, emergency response, fire protection, and ROW safety requirements.

Section 7 discusses the design options for the TWE Project, including a description of Design Options 2 and 3 and the conditions under which each design option would meet the Project purpose and need.

Section 8 summarizes the TWE Project general environmental mitigation measures, which are part of the proposed TWE Project Description, and would be common to all the FEIS alternatives.

Section 9 contains a list of references for this document.

1.5 Relationship with Other Environmental Documents

This FEIS POD has been prepared to support the TWE Project FEIS. The FEIS is being prepared by the BLM and Western, in compliance with the requirements and guidelines of the NEPA and the Federal Land Policy and Management Act of 1976 (FLPMA). This POD provides a description of the TWE Project for the lead agencies' use in preparing the FEIS. The POD contains detailed design, construction, operation and maintenance information for the agencies' use in the analyses of environmental impacts and mitigation measures adopted by the Applicant for the TWE Project and all alternatives analyzed in the FEIS. This FEIS POD is preliminary in that it addresses the range of alternatives being analyzed in the FEIS and incorporates design features, Applicant committed mitigation measures, best management practices, and BLM proposed mitigation measures from the DEIS updated to reflect revisions incorporated in the FEIS. TransWest anticipates preparing one additional preliminary POD at the time of issuance of the ROD (the ROD POD). The POD(s) prepared in connection with TransWest's request for a NTP will be the final POD (the NTP POD). TransWest may file multiple NTP PODs for the Project, each covering a separate construction spread or work management area, but for convenience all such PODs are referred to herein as the NTP POD.

1.6 Background on TransWest Express LLC

TransWest Express LLC is a limited liability company that was formed in July, 2008. TransWest is a wholly owned subsidiary of The Anschutz Corporation (TAC). In turn, TAC is a 100% owned subsidiary of Anschutz Company (Anschutz), a privately held multi-billion dollar diversified company based in Denver, Colorado. The principal offices of TransWest are located at 555 Seventeenth Street, Suite 2400, Denver, Colorado. TransWest was formed to hold and develop certain electric transmission assets for Anschutz.

TAC was formed in 1965 by Philip F. Anschutz, initially as an oil and gas drilling and exploration company. Today, Anschutz has worldwide investments in natural resources (oil and gas development and pipelines, ranching and agriculture), real estate, telecommunications, transportation, sports and entertainment, film production, movie theaters, and newspaper and internet publishing. TAC has successfully developed large and complex energy infrastructure projects. In the 1990s, TAC constructed a 130-mile intrastate common carrier crude oil pipeline to transport heavy crude from California's San Joaquin Valley to refineries and terminal facilities in the Los Angeles Basin.

In 1987, TAC built AREPI Pipeline to transport crude oil from its oil field on the Utah Wyoming border to refineries in Salt Lake City. At its peak, TAC's pipeline company operated over 3,100 miles of pipeline and 14 million barrels of crude oil storage capacity.

In the mid-1990s, TAC founded Qwest Communications which constructed the country's first transcontinental high-speed fiber-optic link between Los Angeles and Boston. The mammoth construction project originated on Southern Pacific/Union Pacific rights-of-way controlled by TAC and expanded onto rights-of-way acquired from federal, state, and local governments and private landowners. In all, Qwest developed a 25,500-mile North American fiber network connecting 250 cities and consisting of approximately 3.4 million fiber miles.

Through its wholly-owned subsidiary Anschutz Entertainment Group (AEG), Anschutz has successfully developed and constructed a number of sports, entertainment and real estate assets, investing several billion dollars. AEG played an integral role in the revitalization of downtown Los Angeles when it constructed the Staples Center, a 20,000 seat mixed use arena that is home to the LA Lakers, LA Clippers,

LA Kings, and other professional sports teams. The arena hosts 250 events and nearly 4 million customers per year. AEG has also constructed a 4.4 million square foot mixed use entertainment district around the Staples Center that is anchored by a 7,100 seat theater and includes hotels, luxury condos, and restaurants. AEG also successfully constructed a number of other development projects including the Home Depot Center in Carson, California, the Sprint Center in Kansas City, the O2 Arena in London, and a 17,000 seat multi-purpose arena in Berlin.

TransWest is an extension of TAC's long and successful tradition of resource development and investment in the western United States. The TWE Project responds to the nation's demand for clean renewable energy while representing TAC's commitment to responsible development and delivery of natural resources. TAC's resources and commitment to developing the TWE Project are demonstrated by the substantial investment of capital and time already made by TAC. Since 2008, TAC has funded all of TransWest's extensive development activities – a period of over five years. This includes undertaking the highest level of environmental review in the United States. To date, TransWest has expended approximately $34 million dollars in developing the TWE Project – a significant capital investment by TransWest and TAC. To date, Western has reimbursed TransWest approximately $8 million dollars of this investment pursuant to the Development Agreement.

1.7 Federal, State, and Local Permits

The Applicant will be responsible for the acquisition of all applicable federal, state, and local permits, licenses and agreements. A list of applicable permit requirements was provided through the NEPA process and incorporated into this POD for the TWE Project. The TWE Project will necessitate crossings of existing electrical transmission lines, U.S. and State Highways, and railroads. The proposed line crossings will be coordinated with the appropriate entity and TransWest will obtain all required licenses, permits, or agreements.

Table 2 is a list of the authorizations, permits, and reviews that may be needed in order for the Project to be constructed and are based on the Agency Preferred Alternative and the Applicant's Proposed Action in the FEIS.

TABLE 2 SUMMARY OF POTENTIAL FEDERAL, STATE, AND LOCAL PERMITS AND ENVIRONMENTAL REVIEW REQUIREMENTS

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
FEDERAL				
National Environmental Policy Act of 1969 (NEPA) Compliance	Federal action: to grant right-of- way (ROW) across land under federal jurisdiction	Lead agencies (Bureau of Land Management [BLM] and Western Area Power Administration [Western]); Affected land-managing agencies; Cooperating agencies	Environmental Impact Statement (EIS) and Record of Decision (ROD)	NEPA (42 United States Code [U.S.C.] § 4321); Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] Parts 1500-1508); Department of Energy (DOE) NEPA implementing Regulations (10 CFR Part 1021)
ROW Across Land Under Federal Management	Preconstruction surveys including geotechnical surveys; construction, operation, maintenance, and abandonment	BLM	ROW grant and temporary use permit	Federal Land Policy and Management Act (FLPMA) of 1976 (PL 94-579); 43 U.S.C. §§1761-1771; 43 CFR Part 2800
		BLM	Short-Term ROW Grant	FLPMA (PL 94-579); 43 U.S.C. §§1761-1771; 43 CFR Part 2800
		BLM	Resource Management Plans	BLM requirements
		BLM	Plan of Development	BLM requirements
		BLM	Notice to Proceed	48 CFR
		BLM	Pesticide Use Proposal	Final Vegetation Treatments Using Herbicides Programmatic EIS (BLM 2007)
		U.S. Bureau of Reclamation (Reclamation)	License Agreement	Technology Transfer Act of 1986 (Public Law 99-502), Section 11
		Reclamation	Right of Use Authorization	Act of Congress of June 17, 1902 (32 Stat. 388), Act of Congress of August 4, 1939 (53 Stat. 1187), Section 10, and 43 CFR 429
		U.S. Department of Agriculture (USDA)	Coordination with the USDA's Farm Service Agency for crossing Conservation Reserve Program lands, if applicable	Title II, Subtitle B of the Food, Conservation, and Energy Act of 2008
		USDA	Coordination with the Natural Resources Conservation Service for crossing Wetland Reserve Program lands, if applicable	Title II, Subtitle C of the Food, Conservation, and Energy Act of 2008
		U.S. Forest Service (USFS)	Special use authorization permit or easement	36 CFR Part 251
		USFS	Operation and Maintenance Plan	USFS requirements
		USFS	Notice to Proceed	48 CFR

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
		USFS	Road Use Permit	16 U.S.C. §§ 535 and 537, National Forest Roads and Trails Act Sections 4 and 6
		USFS	Pesticide Use Proposal	FS Manual 2150
		Bureau of Indian Affairs (BIA), tribe	ROW grant across American Indian lands	25 CFR Part 169
		National Park Service (NPS)	Authorization to cross NPS lands	16 U.S.C. § 79
		U.S. Fish and Wildlife Service (USFWS)	Special use permit for crossing a national wildlife refuge	50 CFR Part 25
		Utah Reclamation Mitigation and Conservation Commission	License Agreement to cross Federal Lands	Central Utah Completion Act, 43 CFR Part 1000
	"Conversion of use" for a use other than recreation on lands reserved with Land and Water Conservation Fund Act (LWCF) monies	NPS	Review of transmission line corridor to identify conflicts with recreational area	Land and Water Conservation Fund Act, Public Law (PL) 88-578, Section 6(f)(3)
	Construction, operation, maintenance, and abandonment of transmission line across or within highway ROWs	Federal Highway Administration	Permits to cross Federal Aid Highway; 4 (f) compliance	U.S. Department of Transportation (USDOT) Act, 23 CFR Part 1.23 and 1.27; 23 U.S.C. §§ 109 and 315; 23 CFR Part 645; 23 CFR Part 771
Biological Resources	Grant ROW by Federal land-managing agency	USFWS	Endangered Species Act (ESA) compliance by Federal land- managing agency and lead agency	ESA of 1973 as amended (16 U.S.C. § 1531 et seq.)
	BLM issuance of a ROW grant covering USFWS fee lands within National Wildlife Refuges	USFWS	Compatibility Determination	National Wildlife Refuge System Administration Act of 1966 as amended by the National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd-668ee
	Protection of migratory birds	USFWS	Compliance	Migratory Bird Treaty Act of 1918, 16 U.S.C. § 703-712; 50 CFR
	Protection of bald and golden eagles	USFWS	Compliance	Bald and Golden Eagle Protection Act of 1972 (16 U.S.C. §668)
Ground Disturbance and Water Quality Degradation	Construction activities that disturb one or more acres of land	U.S. Environmental Protection Agency (EPA)	Section 402 National Pollutant Discharge Elimination System (NPDES) General Permit and accompanying Notice of Intent (NOI) and Storm Water Pollution Prevention Plan (SWPPP) for Storm Water Discharges from Construction Activities	Clean Water Act (33 U.S.C. §1342)
	Construction across water	U.S. Army Corps of	General easement	10 U.S.C. §§ 2668 to 2669

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
	resources	Engineers (USACE)		
	Construction in or modification of floodplains	Federal lead agency	Compliance	42 U.S.C. § 4321 Ex. Ord. No. 11988 Floodplains
	Construction in or modification of wetlands	Federal lead agency	Compliance	42 U.S.C. § 4321 Ex. Ord. No. 11990 Wetlands
	Potential discharge into waters of the state (including wetlands and washes)	USACE (and states); EPA on tribal lands	Section 401 Water Quality Certification	Clean Water Act (33 U.S.C. §1344)
	Discharge of dredged or fill material into waters of the United States, including wetlands	USACE; EPA on tribal lands	Section 404 Permit, Individual or Nationwide Permit	Clean Water Act (33 U.S.C. §1344)
	Placement of structures and construction work in or across navigable waters of the U.S.	USACE	Section 10 permit	Rivers and Harbors Act of 1899 (33 U.S.C. § 403)
	Protection of all rivers included in the National Wild and Scenic Rivers Systems	Affected land-managing agencies	Review by permitting agencies	Wild and Scenic Rivers Act (PL 90-542) (16 U.S.C. §§ 1271-1287)
	Potential pollutant discharge during construction, operation, and maintenance	EPA	Spill Prevention, Control, and Countermeasure (SPCC) Plan for oil-filled equipment	Oil Pollution Act of 1990 (40 CFR Part 112)
Cultural Resources	Disturbance of historic properties	Federal lead agency, State Historic Preservation Officers (SHPO), Advisory Council on Historic Preservation	Section 106 consultation and signed PA prior to Record of Decision	National Historic Preservation Act of 1966, (16 U.S.C. § 470) (36 CFR Part 800)
	Potential conflicts with freedom to practice traditional American Indian religions	Federal lead agency, Federal land-managing agency	Consultation with affected American Indians	American Indian Religious Freedom Act (42 U.S.C. § 1996)
	Disturbance of graves, associated funerary objects, sacred objects, and items of cultural patrimony	Federal land-managing agency	Consultation with affected Native American group regarding treatment of remains and objects	Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) (25 U.S.C. §§ 3001-3002)
	Investigation of cultural and paleontological resources	Affected land-managing agencies	Permit for study of historical, archaeological, and paleontological resources	Antiquities Act of 1906 (16 U.S.C. §§ 432-433)
	Investigation of cultural resources; Excavation of archaeological resources	Affected land-managing agencies	Permits to excavate and remove archaeological resources on Federal lands; American Indian tribes with interests in resources must be consulted prior to issuance of permits	Archaeological Resources Protection Act of 1979 (16 U.S.C. §§ 470aa to 470ee) (43 CFR Part 7)
	Protection of segments, sites, and features related to national trails	Affected land-managing agencies	National Trails System Act compliance	National Trails System Act (PL 90-543) (16 U.S.C. §§ 1241 to 1249)
Paleontological Resources	Ground disturbance on Federal land or Federal aid project	BLM	Compliance with BLM mitigation and planning standards for Paleontological	FLPMA of 1976 (43 U.S.C. §§ 1701-1771); Antiquities Act of 1906 (16 U.S.C. §§ 431-

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
			resources of public lands	433); Paleontological Resources Preservation Act (PRPA) of 2009.
Air Traffic	Location of towers in regards to airport facilities and airspace	Federal Aviation Administration (FAA)	A "Determination of No Hazard to Air Navigation" for structure heights and locations in proximity to public airports	Federal Aviation Act of 1958 (PL 85-726) (14 CFR Part 77)
			Section 1101 Air Space Permit for air space construction clearance	Federal Aviation Act of 1958 (PL 85-726) (14 CFR Part 77)
Rate Regulation	Sales for resale and transmission services	Federal Energy Regulatory Commission (FERC)	Federal Power Act compliance by power seller	Federal Power Act (16 U.S.C. §792)
TRIBAL				
UTE				
ROW Encroachment	Encroachment onto Uintah and Ouray Reservation Land	Ute Indian Tribe-BIA Department of Energy and Minerals	ROW easement	25 CFR Part 169
WYOMING				
STATE				
Wildlife Resources	Permitting within sage-grouse core areas	All State Agencies	Compliance with Executive Order (EO) 2011-5	Sections 1 and 2 of Article V of the Michigan Constitution of 1963; Executive Order 2011-5
	Permitting within state wildlife habitat management areas	All State Agencies	Special Use Permit to cross Wildlife Habitat Management Areas	WS 23-1-302 (a)(iii)
Utility Siting	Primary permitting authority for transmission line siting, county level necessary	Public Service Commission (PSC)	Certificate of Public Convenience and Necessity	WS 37-2-101; PSC-R 202, 204, 205
	Construction of an industrial facility	Department of Environmental Quality (DEQ), Industrial Siting Division	Industrial Development Information and Siting Act Permit	WS 35-12
ROW Encroachment	Non-roadway easement across State Lands	State Board of Land Commissioners	ROW Easement	WS 36-2-107 and 36-9-118
	Encroachment into state roadway ROW	Wyoming Department of Transportation	ROW encroachment permit and accompanying traffic control plan	WS 1-26-813
Ground Disturbance and Water Quality Degradation	Construction sites with greater than one acre of land disturbed	DEQ	Wyoming Pollutant Discharge Elimination System Permit Section 401 Water Quality Certification NOI and SWPPP	WS 35-11-3 Clean Water Act, Section 401
Fish and Wildlife	Project impacts to fish and wildlife species and associated habitat	Wyoming Game and Fish Department (WGFD)	Compliance	WGFD requirements
Air Quality	Fugitive dust emissions generated during construction	DEQ, Air Quality Division	Construction Permit	40 CFR Part 63
Cultural Resources	Surveying and limited testing on state lands	State Historic Preservation Office (SHPO); Office of State	Permit	Wyoming Antiquities Act of 1935; WS 36-1-114-116

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
		Lands and Investments (OSLI)		
	Archaeological data recovery or extensive testing on state lands	SHPO and OSLI	Permit	Same regulation as above
	Disturbance of cultural resources	SHPO	Potential permit	Wyoming Protocol Agreement
	Disturbance of cultural resources	BLM and SHPO	Section 106 Consultation	National Historic Preservation Act of 1966 (NHPA), (16 U.S.C. §470) (36 CFR Part 800)
Explosives	Storage and use of explosives	Varies	Explosives Permit	18 U.S.C. § 40
LOCAL				
Land Use	Construction and operation of Transmission Lines greater than 69 kV	Carbon County	Conditional Use Permit, if applicable	2011 Carbon County Zoning Resolution, Chapter IV, Sections 4.2(b)(5) and 4.8(b)(3)
			Building Permit	2011 Carbon County Zoning Resolution, Chapter VI, Section 6.2(a)(2)
Water Resources	Development in a special flood hazard area	Carbon County	Floodplain Development Permit, if applicable	2011 Carbon County Zoning Resolution, Chapter V, Section 5.1(f)
Land Use	Construction and operation of transmission lines	Sweetwater County	Conditional Use Permit, if applicable	2012 Sweetwater County Zoning Resolution, Section 5(A)(13)(d)(8)
Transportation / Access	Accessing work sites via county roads	Sweetwater County	County Road Crossings and Access Permits, County Road Maintenance Agreements	February 2012 Sweetwater County License Permit Application per Engineering Department
Water Resources	Discharging waste water	Sweetwater County	Small waste water permits	Water quality standards per Sweetwater County District Board of Health
Hazardous Materials	Storing hazardous materials	Sweetwater County	Recordation of Hazardous Material Storage	Sweetwater County Hazardous Chemical Inventory per Local Emergency Planning Committee
Hazardous Materials	Spraying herbicides	Sweetwater County	Noxious Weed Control	Weed control standards per Sweetwater County Weed and Pest Board
COLORADO				
STATE				
Utility Siting	Primary permitting authority for transmission line siting, county level necessary	Public Utility Commission (PUC)	Certificate of Public Convenience and Necessity	Colorado Revised Statutes (CRS) 40-5-101-106; 4 CCR 723-3
Air Quality	Land development	Department of Public Health and Environment, Air Pollution Control Division	Land Development Air Pollutant Emission Notice and Application for Construction Permit	5 CCR 1001-5
Pesticides	Applying pesticides	Department of Public Health and Environment, Water Quality Control Division	Pesticides General Permit	CRS 25-8-101
Hazardous Materials	Transporting hazardous materials on state roads	PUC	Hazardous Materials Transportation Permit	8 Code of Colorado Regulations (CCR) 1507-25

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
	Using explosives for excavation	Division of Public Safety	Type II Explosives Permit	Division of Public Safety regulations
Transportation / Access	Transporting oversized and overweight loads on state roads	Colorado Department of Transportation (CDOT)	Transport Permit for Movement of Extra-Legal Vehicles or Loads	2 CCR 601-4
	Accessing state roads	CDOT	Access Permit	State Highway Access Code
ROW Encroachment	ROW across State Lands	State Lands Trust	ROW Easement	State Land Board policies
	Encroachment into state road ROW	CDOT	Utility/Special use permit	CRS 9-1.5-103
Ground Disturbance and Water Quality Degradation	Construction sites with greater than one acre of land disturbed	Department of Public Health and Environment, Water Quality Control Division	General permit and accompanying SWPPP	5 CCR 1002-61 and CRS 25-8-101
			General permit for construction dewatering	
Cultural and Archaeological Resources	Disturbance of cultural or archeological resources	Office of the State Archaeologist, Office of Archaeology and Historic Preservation	Potential permit	CRS 24-80-401-410
	Treatment of unmarked human graves	Office of the State Archaeologist, Office of Archaeology and Historic Preservation, County Coroner	Review	CRS 20-80-1301-1305
Biological Resources	Habitat modification in wetland or riparian areas	Division of Wildlife	Wildlife certification	CRS 33-5-101-105
LOCAL				
Land Use	Construction and operation of transmission lines	Moffat County	Conditional Use Permit, if applicable	Moffat County Zoning Resolution, Article IV
Transportation / Access	Maintaining county roads	Moffat County	Road Maintenance Permit for Private Entities	Moffat County Road Department Policies and Procedures
	Accessing work sites via county roads	Moffat County	ROW Access Permit	
	Transporting oversized and overweight loads on county roads	Moffat County	Transport Permit	Moffat County Resolution No. 2010-102
Utilities	Installing utilities in county road ROW	Moffat County	Utilities Installation Permit	Moffat County Road Department Policies and Procedures
Land Use	Construction and operation of transmission lines	Rio Blanco County	Conditional Use Permit, if applicable	2002 Rio Blanco County Land Use Resolution, Article IX
Transportation / Access	Accessing work sites via county roads	Rio Blanco County	Driveway ROW Access Permit	Rio Blanco County Road and Bridge Department requirements
	Transporting oversized and overweight loads on county roads	Rio Blanco County	Transport Permit	
	Maintaining county roads for which county funds have not been allocated	Rio Blanco County	Private Construction of County Roads Permit	
UTAH				
STATE				

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
Permitting Process	Proposed transmission line facility	Resource Development Coordinating Committee	Expedites Review of Permitting Process for all State Agencies	Utah Code Annotated (UCA) 63-38d-501, UCA 63-38d-504
ROW Encroachment	Encroachment on, through or over state lands	Division of Forestry, Fire, and State Lands	Application approval	UCA Title 65A
	Encroachment into state roadway ROW	Utah Department of Transportation (UDOT)	ROW Encroachment Permit, Grant of Access Permit, and Traffic Impact Study	UCA 63-46b-3
Ground Surface Disturbance	Project construction	Public Service Commission	Certificate of Public Convenience and Necessity; Approve construction contracts	UCA 54-4-25, R 746-401
	Crossing state lands	Division of Forestry, Fire, and State Lands	Easement onto state lands. Bond may be required.	UCA 65A-7-8, R 652-40
Cultural, Paleontological, and Biological Resources	Crossing state lands	Division of Forestry, Fire, and State Lands	Provide a cultural and/or paleontological and/or biological survey and submit procedures for reasonable mitigation actions	R 652-40-500
Historical and Cultural Review	Impact on historical sites	Division of State History	Notification of Planning Stage and before Construction	UCA 9-8-306
Archaeological Resources	Survey or excavation of archaeological resources on lands owned or controlled by the state	Governor's Public Lands Policy Coordinating Office	Permit to survey or excavate	UCA 9-8-305, R 694-1
Cultural Resources	Discovery of Native American grave on state or non-federal land	Antiquities Section, Division of State History	Notification	UCA R456-1-1-17
Encroachment on State Park Lands	Utility easement on state park lands	Division of Parks and Recreation	Agreement for Granting and Maintenance of Easements or Rights-of-Way across Park Lands	UCA 63-11-10.3
Air Quality	Construction and operation	Air Quality Board	Approval Order for construction activity and accompanying NOI	UCA 19-2-108
			Fugitive Dust Plan Permit	
Water Resources	Construction and operation	Water Quality Board	Utah Pollutant Discharge Elimination System General Permit for Construction Activities, NOI and SWPPP	UCA 19-5-107
	Alteration of bed or banks of a natural stream	Utah Department of Natural Resources, Division of Water Rights	Stream alteration permit	UCA 73-3-29, Administrative Rule R655-13
Wildlife	Modification of habitat	Division of Wildlife Resources	Easement for Use of State Wildlife Resource lands	UCA Title 23
LOCAL				
Land Use	Construction and operation of transmission lines	Uintah County	Conditional Use Permit, if applicable	2006 Uintah County Land Use Ordinance
			Building Permit	Uintah County Building Code, Chapter 14.16
Transportation /	Encroaching onto county road ROW	Uintah County	ROW Encroachment Permit	Uintah County Road Department

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
Access				requirements
Land Use	Construction and operation of transmission lines	Duchesne County	Conditional Use Permit, if applicable	2013 Duchesne County Code, Title 8
			Building Permit	
Transportation / Access	Constructing approaches to county roads	Duchesne County	Permit	2013 Duchesne County Code, Title 6
Utilities	Installing utilities in county road ROW	Duchesne County	Utility Easement	
Land Use	Construction and operation of transmission lines	Wasatch County	Conditional Use Permit, if applicable	2013 Wasatch County Land Use and Development Code, Chapter 16
			Building and Grading permits	
Transportation / Access	Encroaching onto county road ROW	Wasatch County	Driveway Encroachment Permit	2013 Wasatch County Land Use and Development Code, Chapter 14
Ground Disturbance and Water Quality Degradation	Ground-disturbing activities	Wasatch County	SWPPP and Erosion Control Permit	2013 Wasatch County Land Use and Development Code, Chapter 16
Water Resources	Development in a special flood hazard area	Wasatch County	Floodplain Development Permit	
Land Use	Construction and operation of transmission lines	Utah County	Conditional Use Approval, if applicable	2014 Utah County Land Use Ordinance
			Building Permit	
			Zoning Compliance Permit	
Transportation / Access	Accessing work sites via county roads	Utah County	Road Access Permit	Utah County Code, Chapter 17
	Installing utilities in county road ROW	Utah County	ROW Grant	
Utilities	Installing utilities	Utah County	Utility Installation Permit	2014 Utah County Land Use Ordinance
Land Use	Construction and operation of transmission lines	Juab County	Conditional Use Permit, if applicable	2007 Juab County Land Use Code, Section 12-1-15
			Building Permit	Buildings & Grounds Department requirements
Land Use	Construction and operation of transmission lines	Sanpete County	Conditional Use Permit, if applicable	2013 Sanpete County Land Use Ordinance, Chapter 14.68
			Building Permit	Sanpete County Building, Planning, and Zoning Department requirements
Transportation / Access	Accessing work sites via county roads	Sanpete County	Road Access (Approach) Disclosure Form	
Land Use	Construction and operation of transmission lines	Millard County	Conditional Use Permit, if applicable , General Plan Amendment, if applicable	2012 Millard County Code, Titles 7 and 10
			Building Permit	
			Development Permit for flood control	
Transportation / Access	Accessing work sites via county roads	Millard County	Access Permit	
	Construction activities in county road ROW	Millard County	Encroachment Permit	

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
Land Use	Construction and operation of transmission lines	Beaver County	Conditional Use Permit, if applicable	2010 Beaver County Zoning Ordinance, various chapters
		Beaver County	Building Permit	Beaver County Building Department requirements
Transportation / Access	Encroaching onto county road ROW	Beaver County	ROW Encroachment Permit	
Water Resources	Construction in a flood-related erosion-prone area	Beaver County	Flood Control Development Permit	2010 Beaver County Zoning Ordinance, Chapter 10.26
Land Use	Construction and operation of transmission lines	Iron County	Conditional Use Permit, if applicable	1994 Iron County Code, as amended, Titles 12, 15, and 17
			Building Permit	
Transportation / Access	Encroaching onto county road ROW	Iron County	ROW Encroachment Permit and accompanying ROW Encroachment Plan	
Land Use	Construction and operation of transmission lines	Washington County	Conditional Use Permit, if applicable	Washington County Planning Department requirements
			Building Permit	Washington County Building Department requirements
NEVADA				
STATE				
ROW Encroachment	ROW across State Lands	Division of State Lands	Easement	Nevada Revised Statutes (NRS) 322.050
	Encroachment into state roadway ROW	Nevada Department of Transportation	Occupancy Permit for utilities in state ROW	NRS 408.423, 408.210
			ROW Encroachment Permit and accompanying Traffic Control Plan	
Ground Surface Disturbance	Project construction	Nevada Division of Environmental Protection (NDEP)	Registration certificate	Nevada Administrative Code (NAC) 445.704
		Division of Forestry	Timberland Conversion Certificate and accompanying Conversion Plan	NRS 528
			Logging Permit and accompanying Logging Plan	
	Construction of electric transmission line	Public Service Commission	Authority to construct and Certificate of Public Convenience and Necessity	NRS 704.330, NRS 704.820, NRS 704.701
Ground Disturbance and Water Quality Degradation	Construction in or near 100-year floodplains, streams and rivers, or waters of the state	NDEP	Floodplain use permits, Clean Water Act Section 401, 402, and 404 permits	Nevada State Statutes - State Water Quality Certification rules
	Pollutant discharge	NDEP	NPDES Construction Stormwater General Permit, NOI, SWPPP, and SPCC Plan	
Cultural and	Crossing state lands	Division of State Lands	Easement onto state lands	NRS 321.001

ISSUE	ACTION REQUIRING PERMIT, APPROVAL, OR REVIEW	AGENCY	PERMIT, LICENSE, COMPLIANCE, OR REVIEW	RELEVANT LAWS AND REGULATIONS
Paleontological Resources	Investigation of Paleontological, archaeological, and historic sites	Nevada State Museum	Permit to investigate antiquities	Nevada Antiquities Law (NRS 381.195 to 381.227)
	Disturbance of American Indian burial sites on state and private lands	Nevada SHPO	Notification of discoveries, consultation with affiliated groups	Nevada Protection of Indian Burial Sites (NRS 383.150) (NRS 383.190)
Air Quality	Construction and operation	NDEP	Authority to construct, permit to operate	NRS 445
			Surface Area Disturbance Permit for non-agricultural activities of more than 5 acres	
Biological Resources	Modification of sensitive plant species habitat	Division of Forestry	Compliance to survey for identification of plant species	NRS 527.270, NRS 527.050
	Controlling pests	Department of Agriculture	License to engage in pest control	NRS 555.280
	Disturbance of special status plant species	Division of Forestry	Permit for lawful take of protected plant	NRS 527.250
	Construction and operation in areas of rare and endangered animal species	Division of Wildlife	Compliance	NRS 501, NAC 503
	Modification of habitat of threatened and endangered species	Division of Wildlife	Special permit	NAC 5-4.510 through 4.550
LOCAL				
Land Use	Construction and operation of transmission lines	Lincoln County	Special Use Permit, if applicable	Lincoln County Code, Title 13, Chapters 6 and 8
			Airport Zoning Permit	Lincoln County Code, Title 9, Chapter 2
			Building Permit	Lincoln County Code, Title 11, Chapter 2
Air Quality	Construction activities	Clark County Department of Air Quality	Dust Control Permit	Clark County Department of Air Quality requirements
Biological Resources	Construction activities	Clark County	Desert Tortoise Assist	Clark County Desert Conservation Program requirements
Land Use	Construction and operation of transmission lines	Clark County	Conditional Use and Special Use Permits	Clark County Code, Title 30, Chapter 44
			Building and Grading Permits	Clark County Code, Title 30, Chapter 32
			Drainage Compliance Report	Clark County Department of Building
			Geotechnical Report	
Transportation / Access	Encroaching onto county road ROW	Clark County	Encroachment Permit	Clark County Code, Title 30, Chapter 32
	Accessing work sites via county roads	Clark County	Traffic Control Plan	Clark County Department of Public Works requirements
Ground Disturbance and Water Quality Degradation	Construction activities	Clark County	Stormwater Pollution Prevention documentation	Clark County Department of Building requirements

2.0 PURPOSE AND NEED

2.1 TWE Project Objectives and Needs

TransWest's primary goal is to provide the transmission infrastructure and capacity necessary to reliably and cost-effectively transmit up to 3,000 megawatts (MW) of electric power from Wyoming to the Desert Southwest. TransWest's objectives for the Project are to:

- Allow consumers access to renewable energy sources and contribute to meeting national, regional, and state energy and environmental policies, including state-mandated renewable energy portfolio and greenhouse gas reduction targets;
- Meet increasing customer demand with improved electrical system reliability;
- Allow consumers access to domestic energy sources and contribute to complying with national energy policy;
- Provide system flexibility and increased access to the grid for third-party transmission users;
- Expand regional economic development through increased employment and enlargement of the property tax base; and
- Maintain the standard of living associated with highly reliable electricity service.

While meeting these broad objectives, TransWest would work within the following Project-specific objectives:

- Provide for the efficient, cost-effective, and economically feasible transmission of approximately 20,000 gigawatt hours per year (GWh/yr) of clean and sustainable electric energy from Wyoming to markets in the Desert Southwest region. This estimate is based on 8,760 hours per year of 3,000-MW transmission capacity.
- Meet NERC Reliability Standards and WECC planning criteria and line separation requirements.
- Maximize the use of designated federal utility corridors and existing access roads to the extent practicable to minimize adverse effects of the Project.
- Maximize co-location of the Project with existing linear infrastructure generally and, in particular, existing transmission infrastructure to the extent practicable to minimize adverse effects of the Project.
- Provide these benefits in a timely manner to the Desert Southwest region and the broader Western U.S. to meet the region's pressing environmental and energy needs. TransWest has identified a need for the Project by the expected in-service date of 2015 or as soon as the regulatory reviews can be completed.
- Provide for flexibility and maximize the use of infrastructure to increase future transmission capacity by configuring the Project to allow for future interconnection with the IPP transmission system near Delta, Utah.

2.2 NERC Standards and WECC Criteria

The Reliability Standards used within the electric utility industry for the bulk power electrical grid are developed by the NERC. The WECC develops Regional Criteria that supplement the NERC Standards. The West-Wide Energy Corridor (WWEC) Final Programmatic Environmental Impact Statement includes a comprehensive overview of this subject in Chapter 2, Section 2.6.3, *What Steps Are Being Taken To Ensure The Reliability of Bulk Electricity Transmission* (DOE et al. 2008). The overview includes a description of how NERC and WECC regulate the industry through a wide series of standards that address all facets of the bulk electricity transmission grid, including design, planning, operations, infrastructure and cyber security, communication, coordination and operational safety.

These reliability standards affect the technical aspects of the TWE Project in several ways. Reliability standards limit the operational capacity of any single transmission system element based on a complex contingency analysis that considers the impact to grid operations following various events (e.g., equipment failures, line outages).

Reliability standards affect the TWE Project ROW requirements and separation requirements from other high voltage lines. As a single transmission system element, the TWE Project is effectively limited in capacity to approximately 3,000 MW.

The contingency analysis required for new transmission projects such as the TWE Project involves examining several types of events including the loss of "Adjacent Transmission Circuits" and the loss of multiple transmission lines within a corridor.

WECC's Regional Criteria addresses separation distances based upon the location of a project from Adjacent Transmission Circuits. WECC requires a minimum separation distance between high voltage transmission lines. The WECC Regional Criteria specifies that to avoid being rated as Adjacent Transmission Circuits, or common transmission system elements, circuits must be separated by "at least 250 feet between the transmission circuits" (WECC 2012). The applicability of this portion of the Regional Criteria is for circuits greater than or equal to 300 kV. The loss of multiple lines within a corridor involves analyzing impacts after a line outage of the TWE Project transmission line and any other transmission line(s) within the corridor. The most likely event would be the loss of the TWE Project and an adjacent transmission line.

The likelihood of having a line outage of two transmission lines is even higher at places where transmission lines cross one another. The mechanical failure of the top line would typically cause the line below to also fail. The practicality of needing transmission lines to cross is recognized in the standards; however, the number of crossings needs to be minimized to reduce the likelihood of such an event.

Reliability analysis examining the scenario where multiple lines are lost including the TWE Project has shown this loss will have a significant impact on transmission grid performance, including local and widespread transmission grid blackouts. This reliability analysis has found that the higher the capacity of the line lost along with the TWE Project, the more severe the transmission grid performance consequences. The reliability analysis also demonstrated that it is not feasible for the TWE Project and another transmission project to use common structures for any portion of the route.

TransWest has developed minimum line separation requirements based on the "tower height" dimensions adopted by WECC in 2012. This tower height dimension takes into consideration both the height and width of typical transmission line structures and is meant to prevent a tower failure of one

line from impacting the adjacent line. Application of the NERC and WECC reliability standards and preliminary transmission system contingency analyses indicate that the proposed Project transmission line centerline should be optimally no closer than 250 feet from parallel transmission line centerlines rated 230 kV and above. The 250 foot separation criteria will allow for safe and reliable operation of the Project, as well as more efficient use of designated and existing utility corridors and will reduce the extent of the disturbance associated with access roads and other potential impacts caused by construction in a new transmission corridor.

2.3 Renewable Energy and Transmission

The TWE Project will provide the transmission infrastructure and capacity necessary to reliably and cost-effectively deliver approximately 20,000 GWh/yr of clean and sustainable electric power generated primarily from renewable wind energy resources in Wyoming to the Desert Southwest. Another major benefit of the TWE Project is to facilitate the states of the Desert Southwest in their ability to meet their renewable energy needs and Renewable Portfolio Standards.

Wind and solar have been cited in numerous studies as the most economic large scale resources that can be used to meet the Nation's demand for renewable and clean energy. However, developable solar and wind resources are typically found in remote areas located far from urban centers where the demand is the greatest. Thus, transmission infrastructure is required to enable renewable energy development that will meet both the demand for energy and environmental policy objectives.

In its July 2008 report entitled "20% Wind Energy by 2030, Increasing Wind Energy's Contribution to U.S. Electricity Supply" (DOE 2008), the DOE recognized the challenge of bringing wind energy to market. According to the DOE report:

> "If the considerable wind resources of the United States are to be utilized, a significant amount of new transmission will be required. Transmission must be recognized as a critical infrastructure element needed to enable regional delivery and trade of energy resources, much like the interstate highway system supports the nation's transportation needs…Significant expansion of the transmission grid will be required under any future electric industry scenario. Expanded transmission will increase reliability, reduce costly congestion and line losses, and supply access to low-cost remote resources, including renewables."

In discussing required improvements to the nation's transmission infrastructure necessary to achieve 20% wind energy by 2030, the DOE report concludes:

> "The 20% Wind Scenario would require widespread recognition that there is national interest in ensuring adequate transmission. Expanding the country's transmission infrastructure would support the reliability of the power system; enable open, fair, and competitive wholesale power markets; and grant owners and operators access to low-cost resources. Although built to enable access to wind energy, the new transmission infrastructure would also increase energy security, reduce GHG emissions, and enhance price stability through fuel diversity."

The electrical demand for the Desert Southwest region is also expected to increase over the next ten to twenty years. According to the U.S. Census Bureau, the western United States has experienced a population growth of approximately 10 percent from 2000 to 2006. The Bureau expects the growth in population to increase by 33 percent between 2006 and 2030. The Bureau's latest projection of population growth between 2000 and 2030 for the combined area of Arizona, California, and Nevada is nearly 50 percent (U.S. Census Bureau 2005). Arizona and Nevada were identified as the fastest growing states during this period (U.S. Census Bureau 2005a).

Population increase is a key driver in the projected increase in electrical demand, although it is not the only factor. The amount of electricity used per person is also expected to increase as the scope and expectation for the uses of electricity increases. The per capita increase is due to the continued electrification of day to day life, including the expanded deployment of air conditioning, computers, high-definition televisions, and potentially, electric powered automobiles. While this upward tendency on per capita electricity usage is countered by conservation efforts in the form of energy efficiency standards, utility programs, and individual responsibility, overall per capita electricity usage is still expected to increase (Global Environment Fund 2008). Therefore, even accounting for conservation programs, the electricity demand is expected to increase on the order of two percent per year in the Desert Southwest region (ICF International 2009).

The increase in overall forecasted electric demand in the Desert Southwest region will require the addition of 55,000 GWh/yr of renewable energy by 2020 to satisfy projected Renewable Portfolio Standards (RPS) requirements. Even with significant gains in energy efficiency and/or slower than expected growth, the need to access new renewable resources remains. For instance, if overall demand for electricity is 15 percent below the forecasted levels for 2020, the estimated requirements for additional renewable energy would only change from 55,000 GWh/yr to 45,000 GWh/yr (ICF International 2009).

2.3.1 Relevant State Laws and Regulations – Renewable Energy Resources and Standards

Arizona, California, Nevada, and Utah have adopted renewable energy standards, commonly referred to as RPS. These states have enacted legislation that requires utilities to meet a portion of the overall customer energy supply with renewable energy resources by specific dates. Each state has adopted programs that vary in the portion of overall renewable energy required, the deadlines, and the type of resources that can be utilized. Beyond the legislated RPS, California, which has a 20 percent renewable energy requirement by 2010, has recently adopted a policy to increase the requirement to 33 percent by 2020. A brief summary of each state's RPS requirements follows.

California. California's RPS was initially established by the State of California legislature in 2002. In 2011, the State of California legislature enacted [Senate Bill 2] that codified a 33% Renewable Portfolio Standard by 2020 that would apply to all utilities, including publicly-owned municipal utilities.

Arizona. In November 2006, the Arizona Corporation Commission (ACC) adopted final rules to expand the state's Renewable Energy Standard (RES) to 15% by 2025. In June 2007, the state attorney general certified the rule as constitutional, allowing the new rules to go forward and they took effect 60 days later. Investor-owned utilities serving retail customers in Arizona are subject to the standard.

Utilities subject to the RES must obtain renewable energy credits (RECs) from eligible renewable resources to meet 15% of their retail electric load by 2025 and thereafter. Of this percentage, 30% (i.e., 4.5% of total retail sales in 2025) must come from distributed renewable resources by 2012 and thereafter.

Nevada. Nevada established a RPS as part of its 1997 restructuring legislation. Under the standard, NV Energy (parent company of Nevada Power, Sierra Pacific Power, and Sierra Pacific Resources) must use eligible renewable energy resources to supply a minimum percentage of the total electricity it sells. In 2001, the state increased the minimum requirement by two percent every two years, culminating in a 15% requirement by 2013. The portfolio requirement has been subsequently revised,

most recently by Senate Bill (SB) 358 of 2009, which increased the requirement to 25% by 2025. In addition to solar, qualifying renewable energy resources include biomass, geothermal energy, wind, certain hydropower, and waste tires (using microwave reduction).

2.3.2 Greenhouse Gas Reduction Goals

In addition to RPS mandates, states and the federal government are also considering various Greenhouse Gas (GHG) reduction policies. Several western governors, including the governors of California, Arizona, and Utah, formed the Western Climate Action Initiative in 2007 to jointly reduce regional GHG levels. A regional goal has been established by the members of the Initiative and details of the economy-wide (e.g., electricity, transportation, industry) program is being developed. GHG reduction policies are also being considered at the federal level. This need for additional renewable energy could be greater depending on how GHG reduction is implemented by utilities (DOE 2008; ICF International 2009).

2.3.3 Wyoming's Abundant and Cost Effective Resources

According to the National Renewable Energy Lab (NREL), Wyoming has one of the densest concentrations of high class wind energy potential in the country (NREL 2006, 2008). NREL data shows that over 50 percent of the best quality (Class 6 and 7) wind capacity in the continental United States is located in Wyoming. This Class 6 and 7 wind resource has an energy potential of 235,000 GWh/yr. Wyoming's Class 4 and above wind resource has a potential of 944,000 GWh/yr. Wind and other energy developers have been very active in Wyoming.

The existing transmission capacity available to export electric energy from Wyoming is fully committed. These constraints led to the recommendations for transmission expansion along similar routes as the TWE Project from the Western Governors Association (WGA), the Rocky Mountain Area Transmission Study (2004), and the Clean and Diversified Energy Advisory Committee (WGA 2006). In addition to wind resources, Wyoming has a number of other natural energy resources that could also be developed for production of electricity and transmitted on the infrastructure to be constructed pursuant to the TWE Project to the growing markets in the Desert Southwest region. The WGA and DOE have identified over 14,000 MW of high quality developable wind resources within Wyoming (WGA and DOE 2009).

Two recent studies, one by the Western Electricity Industry Leaders, have looked specifically at regional renewable energy alternatives, including remote resources supplied through new transmission infrastructure, to meet the needs of the Desert Southwest region. Wyoming wind resources were identified as one of the most economic alternatives to meet a portion of the overall needs (NREL 2006, 2008). The TWE Project will cost effectively provide up to 20,000 GWh/yr of the estimated 55,000 GWh/yr need for renewable energy need in the Desert Southwest region.

3.0 ROLES AND RESPONSIBILITIES

The following section describes the roles and responsibilities of each major Project entity. If other parties become engaged in the Project as additional participants, they would be responsible to function and abide by the roles and responsibilities outlined in this section and their reporting relationships would be case-specific according to their jurisdiction, expertise, and/or nature of their input.

3.1 TransWest

TransWest as the Applicant will be responsible for the administration of the ROW and coordination with the Construction Contractor(s). TransWest and its Construction Contractor(s) will be responsible for all activities associated with the construction, operation, and maintenance of the transmission line and ancillary facilities in a manner that complies with the conditions outlined in the ROW grants, special use authorizations, and other permits listed in Table 2 in Section 1 of this POD. TransWest will be the ultimate authority for its contractors; however, for execution purposes of this document, it will refer specifically to the Construction Contractor(s) when needed to define their activities. To help ensure construction activities are conducted in a manner that complies with all federal, state, and local regulations, the Construction Contractor(s) will contract with or employ a multi-disciplinary team of environmental specialists and inspectors to work jointly and cooperatively with the third party Compliance Inspection Contractor (CIC). TransWest will also maintain regular and consistent communication with the Construction Contractor(s) to track the success of environmental protection, mitigation, and compliance efforts before, during, and after construction.

3.2 Western

Under the Hoover Act, as amended by Section 402 of the Recovery Act, Western was granted authority to borrow funds from the U.S. Treasury to (among other things) construct, finance, facilitate, plan, operate, maintain, and/or study construction of new or upgraded transmission facilities that facilitate the delivery of renewable energy. Prior to committing funds, Western must certify that a project is in the public interest; a project will not adversely impact system reliability, system operations, or other statutory obligations; and it is reasonable to expect the proceeds from the project will be adequate to make repayment of the loan.

Western created the Transmission Infrastructure Program (TIP) to administer the use of borrowing authority and on March 4, 2009 solicited interest in proposed transmission projects that promote the delivery of clean, renewable power. This resulted in the submission of Statements of Interest, including one for this Project. Western is considering whether to participate in the Project as a joint owner with TransWest as part of Western's TIP and in order for Western to participate, the Project must satisfy Western's TIP requirements. As with the BLM's decision, Western's decision is informed by the required NEPA analysis and disclosure in the EIS.

Should Western decide to participate in the Project as a joint owner with TransWest, the decision would be managed through agreements that would include defining the respective rights and obligations associated with the ownership of the Project which include financing, ownership structure, operations, maintenance, marketing and acquisition of ROWs for the Project on private lands. As a federal agency, Western would need to comply with all applicable laws and policies for the joint ownership of transmission projects, and comply with the stipulations included within the Record(s) of Decision and other similar authorizations made by the respective federal land management agencies.

3.3 BLM, USFS, and Other Federal Land Management Agencies

The role of the BLM, USFS, and other federal agencies is to ensure that all stipulations and requirements of the ROW grants, special use authorizations, and the POD are implemented and complied with during the construction, operation, and maintenance of the Project on the lands they administer. Oversight will be provided by both federal Authorized Officers and by federal Project Managers for each involved federal agency. Authorized Officers will have ultimate authority and be the decision makers for issues pertaining to ROW grants and authorizations. The Authorized Officers will supervise the federal Project Managers to verify that environmental compliance is meeting the requirements of all applicable laws, permits, regulations, and agreements. The Authorized Officers, in coordination with others, will determine if noncompliance events for which TransWest is accountable qualify as violations to the terms and conditions of any ROW grant or authorization. Only the Authorized Officers, in accordance with 43 CFR Part 2807 and 36 CFR Part 251.60, will have the authority to suspend or terminate a ROW grant or authorization if TransWest and/or its Construction Contractor(s) do not comply with the stipulations, conditions, or with other applicable laws and regulations. The Authorized Officers will be the primary federal agent to issue decisions unless otherwise delegated to a federal Project Manager.

Federal Project Managers will be primarily responsible for ensuring stipulations and mitigation measures in the POD are adhered to during Project construction, operation, and maintenance. They will ensure that compliance during construction is done in a manner which facilitates timely and efficient construction while protecting the public interest and the environment. They will also be responsible for ensuring that environmental impacts do not exceed those analyzed in the Final EIS and will manage the CIC. Federal Project Managers will coordinate with agency resource specialists for their technical expertise and input when needed. Federal Project Managers will be responsible for notifying TransWest of any grant or authorization violations due to noncompliance, issue Notices to Proceed, issue work stoppage order (WSO) if needed, issue resume work orders and resolving any conflicts that arise relating to the Project on lands they administer.

As described in the Environmental Compliance and Monitoring Plan (ECMP) (Appendix G), Level 2 variance requests will require approval by the appropriate federal Project Manager and Level 3 variance requests will require approval by the appropriate federal Project Manager and Authorized Officer.

3.4 Compliance Inspection Contractor (CIC)

TransWest and the federal agencies have agreed to use a third-party CIC to act on the BLM and other federal land management agencies' behalf to ensure adequate oversight during the construction and reclamation phases of the Project. The CIC will be hired by TransWest prior to issuance of any NTP to allow adequate time for the CIC to review documents and develop on-the-ground familiarity with the Project. The CIC will report directly to each federal Project Manager and will be authorized to enforce the POD, stipulations of the ROW grant and authorizations. It is not the role of the CIC to direct the work of either TransWest or its Construction Contractor(s). Rather the CIC's primary role is to observe work activities and bring noncompliant situations to the attention of the appropriate party and offer recommendations on how to prevent noncompliance. Additional responsibilities of the CIC are discussed in the ECMP (Appendix G).

The CIC will deploy an adequate number of field personnel to sufficiently monitor all constructions activities and fulfill the responsibilities listed above. It is important to note that it is not the role of the CIC to direct work of either TransWest or the Construction Contractor(s) and the CIC will take no

direction from them with respect to times, places, or manner of conducting compliance monitoring. The CIC is to have complete access to inspect all parts of the Project.

3.5 Construction Contractor(s)

The Construction Contractor(s) will be contractually bound to comply with all laws, regulations, and permit requirements, including the implementation of mitigation measures, environmental mitigation measures (EMMs), and other specific stipulations and methods set forth in the ROW grants, special use authorizations, permits, POD, FEIS, ROD, and NTPs throughout all construction phases of the Project. All construction personnel and employees entering the ROW will be required to participate in environmental training before entering the ROW. Construction crews will also be required to cooperate and support the work of the environmental inspectors, monitors, and CIC to build the Project safely and in compliance with all Project terms and conditions; federal, state, and local laws and regulations; and all landowner agreements. If a noncompliance event occurs during construction, it will be the responsibility of the Construction Contractor(s) to notify TransWest and the CIC and to cooperate fully in developing and implementing a solution as soon as possible to resolve the noncompliance. The Construction Contractor(s) will also be responsible for the removal of noncompliant personnel, as necessary. The Construction Contractor will be expected to involve the CIC in key project management meetings and the project safety program.

3.6 Communication Procedures

Effective communication and the sharing of information between all parties will be critical to achieving and maintaining environmental compliance throughout the construction of the Project. It is especially important for construction crews to communicate daily with environmental monitors concerning work schedules and locations. The Construction Contractors(s) will be responsible for assuring that field crews have the ability to communicate effectively and will implement solutions if communication problems arise.

Given the scope and complexity of the Project, it is critical that all communications involving key decisions, safety, approvals, noncompliance, or variances be documented in writing. Oral communication will not substitute for written approvals. Additional information concerning communication procedures can be found in the ECMP (Appendix G) and in the Traffic and Transportation Management Plan (Appendix U).

4.0 PROJECT COMPONENTS

Sections 4.1 through 4.4 describe the typical design characteristics for the proposed TWE Project facilities and associated permanent and temporary land disturbance estimates:

- Section 4.1 – the TWE Project transmission line, including structure designs and foundations, conductors, insulators and associated hardware, overhead shield (ground) wires, grounding rods, minor hardware, system interconnection lines and access roads.
- Section 4.2 – the TWE Project Northern and Southern Terminals, including the AC/DC converter stations, substation equipment.
- Section 4.3 – the TWE Project ground electrode systems, including the ground electrode facilities and low voltage electrode connector line(s).
- Section 4.4 – the TWE communication system for command control of the transmission system.

Appendix AA provides the revised indicative disturbance data tables for the project components by FEIS alternative route segments and an updated description of the methodology used to determine the indicative disturbance levels for access roads for analysis in the FEIS.

4.1 Transmission Line Design Characteristics

The TWE Project proposed ±600 kV DC transmission line will be approximately 750 miles long, located in a ROW 250 feet wide. The design characteristics of the ±600 kV DC transmission line are summarized in Table 3 and are described in this section.[1]

TransWest has determined that a ROW width of 250 feet is sufficient for the long-term maintenance and operation of the transmission line and will accommodate any of the transmission structure designs under consideration. Increased ROW width may be required in a small number of site specific locations to accommodate unusually long spans. These exceptions will be identified and addressed on a case-by-case basis during final design and engineering of the transmission line. ROW width for the TWE Project is based upon engineering studies that considered:

- Structure configuration (horizontal vs. vertical configurations), pole spacing, and insulator configuration (I-string vs. V-string insulator configurations);
- Operating voltage, elevation and clearance criteria (National Electrical Safety Code [NESC] and project-specific);
- Conductor size, weight, number and configuration of conductors in the bundle, tensions, and sag;
- Span length between structures and conductor blowout (conductor movement envelope under pre-defined wind conditions);

[1] Short segments of 500 kV AC and 230 kV AC transmission lines will be required near the Northern and Southern Terminals to connect to the existing and planned regional transmission grid. The design characteristics of these transmission structures are described in Section 4.1.1.

- Structure footprint (guyed vs. self-supported), terrain and maintenance access (space requirements for maintenance equipment at each structure site);
- Audible noise levels at the edge of the ROW; and
- Potential co-location with buried underground high pressure natural gas and other petroleum pipelines within the same corridor. The DC transmission line can be located in its ROW adjacent to the ROW for such pipelines.

TABLE 3 TYPICAL ±600 KV DC TRANSMISSION LINE DESIGN CHARACTERISTICS

FEATURE	DESCRIPTION
	Physical Properties
Line Length	Miles per route segment depending on selected alternative.
Structure Type	Proposed Structure Type: guyed steel lattice; Alternative Structure Types: self-supporting steel lattice, tubular steel poles
Structure Height	Guyed steel lattice -120 to 180 feet; self-supporting steel lattice -120 to 180 feet; tubular steel poles - 100 to 150 feet (special crossing structures may be in excess of 200 ft.)
Span Length	Guyed lattice - 900 to 1,500 feet; self-supporting steel lattice - 900 to 1,500 feet; tubular steel poles - 700 to 1,200 feet
Number of Structures per Mile	Four to eight - depending on structure type, terrain, and other factors to be identified through detailed design studies
ROW Width	250 feet; Increased ROW may be required in a small number of site specific locations to accommodate unusually long spans
	Land Temporarily Disturbed
Structure Work Area	ROW width (250 ft) x 200 feet per structure
Wire-Pulling and Tensioning Sites	ROW width (250 ft) x 500 feet for dead-end structure (two sites at all dead-end structures); ROW width (250 ft) x 500 feet for mid-span conductor and shield wire (approximately every 9,000 feet); 100 x 500 feet for fiber optic cable set-up sites (approximately every 18,000 feet)
Material Storage Yards	Located approximately every 30 miles of transmission line Typical material storage yard area: approximately 20 acres
Staging Areas / Fly Yards	Located approximately every 5 miles of transmission line Typical fly yards/staging areas: approximately 7 acres
Batch Plant Sites	Located approximately every 15 miles of transmission line Stand-alone temporary batch plants, estimated size: approximately 5 acres
Guard Structures	100 x 100 feet at road and existing overhead electrical line crossings
	Land Permanently Disturbed
Structure Base[1]	Guyed lattice (tangent) - 500 square feet (100 square feet mast foundation + 4 x 100 square feet for anchors) Self-Supporting Lattice (tangent) - 900 square feet (30 x 30 feet tower base) Self-Supporting Lattice (angle) - 1,225 square feet (35 x 35 feet tower base) Self-Supporting Lattice (dead-end) - 1,600 square feet (40 x 40 feet tower base) Tubular Steel Pole (tangent) - 40 square feet (7-foot diameter foundation) Tubular Steel Pole (dead-end/angle) - 100 square feet (two poles x eight-foot diameter foundations)
Regeneration Sites	Located approximately every 50 miles of transmission line, most located on the transmission line ROW and each approximately 10,000 square feet (100 x 100 feet).
	Access Roads
Existing Paved Roads[2]	Existing paved roads are typically highways and state routes that will be used for

FEATURE	DESCRIPTION
	travel to existing and new dirt roads to access the ROW.
Existing Dirt and Gravel Roads (no improvement)[2]	Existing dirt and gravel roads with wide (at least 14 feet), well graded or graveled surfaces that do not require improvement beyond regular maintenance, which could include, but not be limited to, blading of the road surface, placing gravel in low spots and repair of drainage structures within the previously disturbed area of road .
Existing Dirt Road (with improvements)	Existing dirt roads that may require improvement. The bladed road surface may need to be widened to 14 - 24 feet depending on terrain. Total disturbance, including that for drainage, cut and fill, may extend beyond the bladed road surface especially in steep terrain where the maximum total disturbance width will typically not exceed 52 feet, but will be determined in consultation with the land management agency or landowner on a case-by-case basis. Surface disturbance outside of the bladed road surface will be limited to the smallest area necessary while still providing a safe work area.
New Dirt Access Road (bladed)	Typically constructed with a 14 foot wide bladed surface with two or three foot berms or ditches on either side, but can be wider in steep and mountainous terrain because of cut and fill requirements according to ground slope. Based on the terrain and grade of the road, new bladed access roads to be constructed with an inslope or outslope design with water dips, water breaks and wings in the berm as necessary to manage water flow and mitigate erosion. Total disturbance, including that for drainage, cut and fill, may extend beyond the bladed road surface especially in steep terrain where the maximum total disturbance width will typically not exceed 52 feet, but will be determined in consultation with the land management agency or landowner on a case-by-case basis. Surface disturbance outside of the bladed road surface will be limited to the smallest area necessary while still providing a safe work area.
Overland Access	Overland access ("drive and crush") where terrain and soil conditions are suitable. No blading or grading required. Some areas may require taller vegetation to be removed while still leaving the root systems intact, as well as, rocks to be removed and placed outside the travel surface in order to utilize overland access. Access surface will typically not exceed 14 feet in width but will be determined in consultation with the land management agency or landowner on a case-by-case basis.
Electrical Properties	
Nominal Voltage	±600 kV DC
Nominal Capacity	3,000 MW (as measured at the Southern Terminal)
Circuit Configuration	DC Bi-Pole Bundled
Conductor Size	Approximately 1.5 inch diameter aluminum conductor steel reinforced (ACSR) conductor bundled with three or four sub-conductors per pole.
Ground Clearance of Conductor	37 feet minimum at a conductor temperature of 176 degrees Fahrenheit (°F)

Notes: [1] Structure types to be used in site-specific settings will be determined during engineering and design of the Agency Preferred Alternative. Tangent self-supporting lattice structures were used to calculate permanent disturbance since this structure type would result in greater disturbances per structure than the proposed guyed lattice structure.
[2] Existing paved, gravel, and dirt public and private roads that can be used to access the FEIS corridor are part of the Backbone Access Road Network described in Appendix Z Revised Access Road Methodology for FEIS Memorandum (February 2014).

4.1.1 Structure Types

The TWE Project transmission line will be constructed primarily with guyed lattice structures (Figure 1). Self-supporting steel lattice and single shaft tubular steel poles (Figures 2 and 3) would be used in selective locations where engineering or other site-specific considerations determine that the guyed lattice steel structure is not appropriate. Table 4 indicates the general suitability of the transmission structure designs by characteristic settings. Figure 4 shows each structure design within a typical 250 foot-wide ROW.

The guyed lattice structure shown on Figure 1 is the proposed tangent design for most locations due to its smaller disturbance area, constructability and overall cost considerations. In addition to tangent structure configurations, specialized structures will be engineered wherever the line must change direction. Specialized structures require the use of either self-supporting lattice or single shaft tubular steel poles. Each angle structure will be individually designed, taking into consideration both the degree of the angle and site-specific geologic conditions, to withstand the increased lateral stress of conductors pulling in two different directions. Angle structures are stronger and have deeper foundations than tangent structures. The term 'dead-end' or 'strain' structure typically refers to a structure where the conductors are separated and connected together (electrically) by a jumper. These dead-end structures are typically placed at locations where the transmission line significantly changes direction.

The TWE Project will be designed in accordance with guidelines established by the Avian Power Line Interaction Committee (APLIC 1994, 2006, 2012). Appendix B provides the framework level Avian Protection Plan for the FEIS.

During detailed engineering and design of the selected Alternative, a series of structure types will be designed to meet the project-specific design criteria. These project-specific design criteria address industry standards and guides, legislated requirements, anticipated environmental conditions, terrain, applications (settings) and land use. In addition to the common or standard structure types designed and to be used across the project, a small number of unique and special structures will be designed to address site-specific conditions such as long spans due to terrain or sub-regional conditions such as weak sandy soils, landslide areas or highly corrosive soils.

TABLE 4 ±600 KV DC TRANSMISSION LINE DESIGN ALTERNATIVES POTENTIALLY USED IN CHARACTERISTIC SETTINGS

CHARACTERISTIC SETTING	GUYED STEEL LATTICE	SELF SUPPORTING STEEL LATTICE	TUBULAR STEEL POLE
Flat to Rolling Terrain	X		
Steep to Mountainous Terrain and Steep Side Slopes	*	X	X
Open Lands	X		
Agricultural Fields, Urban Areas		X	X
Highly constrained ROW			X
Line Angle 0-2°	X		
Heavier Line Angles and Dead-end Strain Structures		X	X

* Should helicopter erection of structures be preferred or required, guyed lattice steel structures may be utilized in steep to mountainous terrain as long as specific structure locations do not have excessively steep side slopes.

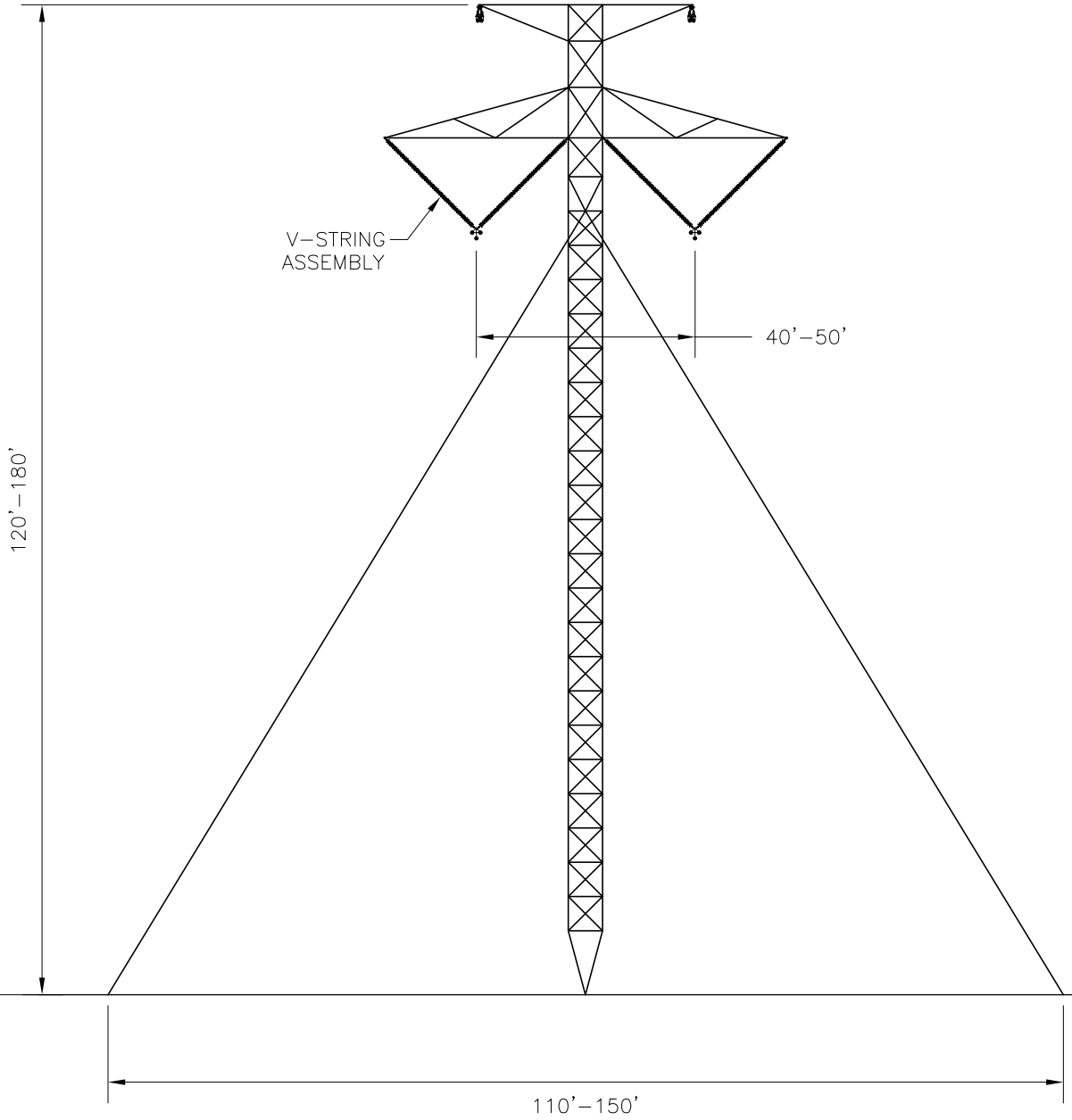


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FIGURE 1

TYPICAL ±600kV DC
GUYED V–STRING
LATTICE STRUCTURE

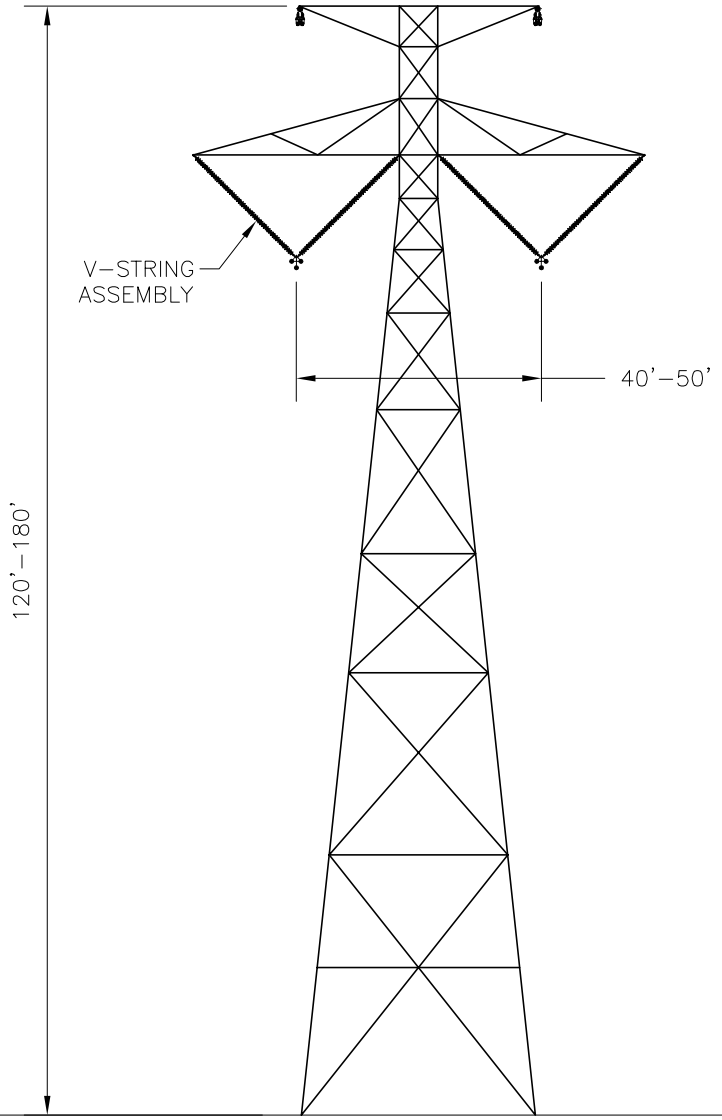

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FIGURE 2

TYPICAL ±600kV DC
SELF SUPPORTING LATTICE
V–STRING STRUCTURE

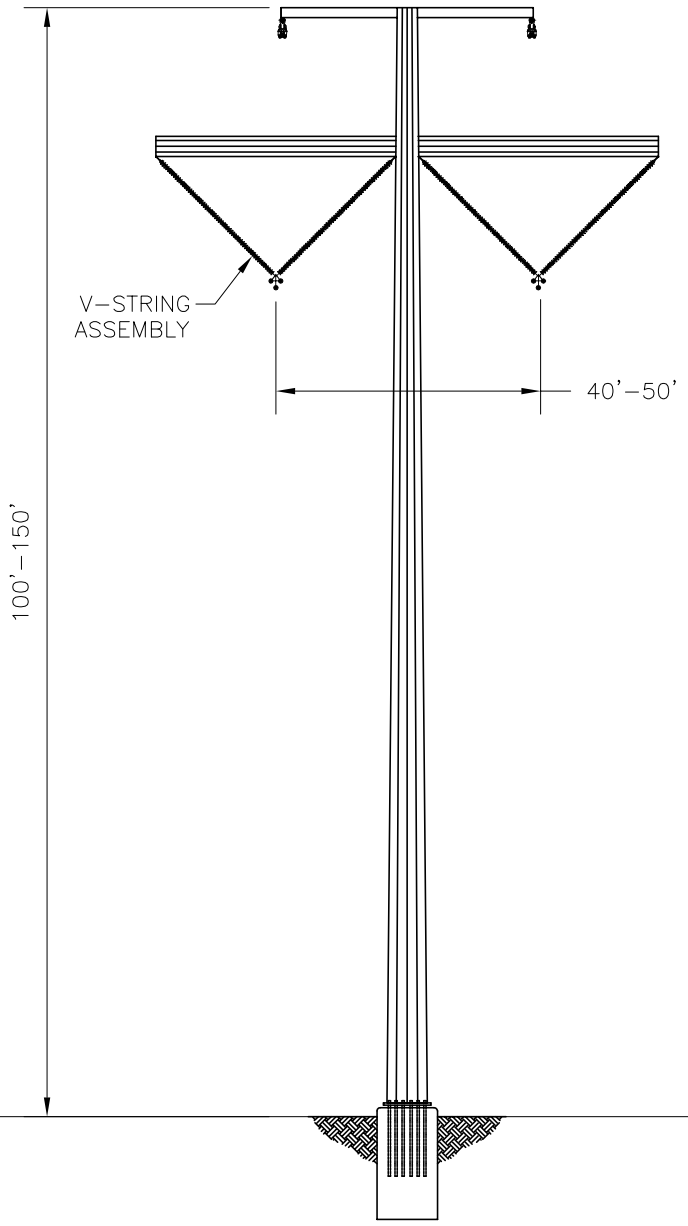

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FIGURE 3

TYPICAL ±600kV DC
TUBULAR STEEL POLE
V–STRING STRUCTURE

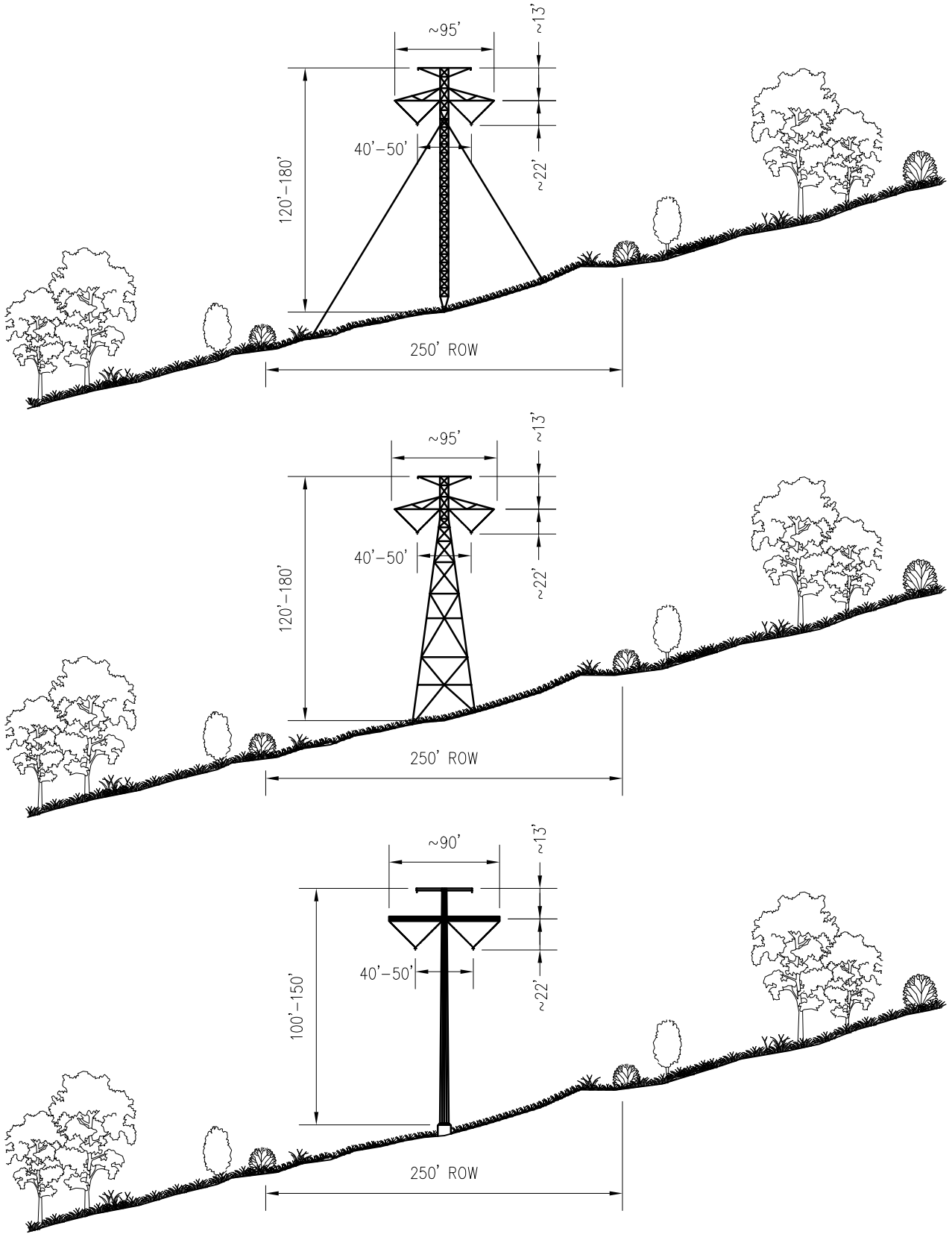

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FIGURE 4

TYPICAL ROW CROSS SECTIONS
BY STRUCTURE TYPE

4.1.2 Structure Foundations

The guyed steel lattice towers will generally require one precast concrete support pedestal for the tower base and four anchors for guy cables. The typical precast concrete support pedestal will be three to six feet in diameter and four to six feet in depth. Due to site-specific characteristics, some foundations may require a cast-in-place reinforced concrete support pedestal. The anchors for attachment of the guy cables will be anchors designed for soil/rock conditions at each site.

Self-supporting lattice towers will require four foundations with one foundation on each of the four corners (legs) of the lattice towers. The foundation diameter and depth will be determined during final design and are dependent on the type of soil or rock present at each specific site. Typically, the foundation for each leg of the structure will be a reinforced cast-in-place concrete drilled pier, with a typical diameter of three to four feet and a depth of approximately 12 to 25 feet. Foundations for dead-end and angles structures will be larger, typically ranging from five to eight feet in diameter and 20 to 50 feet in depth.

Tubular steel pole towers will require one cast-in-place concrete foundation per steel pole. These tubular steel towers will be installed on a single reinforced concrete pier with anchor-bolts connecting the tubular pole base plate to the foundation. The foundation diameter and depth will be determined during final design and are dependent on the type of soil or rock present at each specific site. Foundations for these structures will typically be six to ten feet in diameter and 20 to 60 feet in depth.

In a limited number of locations, specialized foundations may be required to address shallow rock, landslide prone areas, unstable soils, corrosive soils, weak sandy soils, shallow water table, etc. These site specific or sub-region specific foundation designs may include micro-pile, helical pile, grouted, epoxy, grillage, driven pile, vibratory pile and/or steel caisson type designs. All specialized foundations will be determined during final design.

4.1.3 Conductors

Design Characteristics

The proposed conductor for the TWE Project transmission line is an ACSR/TW (Aluminum Conductor Steel Reinforced/Trapezoidal Wire) conductor approximately 1.5 inches in diameter. Each pole of the ±600 kV bipole[2] line will be composed of three or four subconductors in a triple-bundle or quad-bundle configuration. The individual conductors will be bundled in either a triangular configuration (triple-bundle) or a diamond configuration (quad-bundle) with spacing of approximately 18 inches between subconductors. The bundled configuration is proposed to provide adequate current carrying capacity and to provide a reduction in audible noise and radio interference as compared to a single large-diameter conductor. Each ±600 kV subconductor will have a non-specular finish[3].

Ground Clearance Requirements and Guidelines

Conductor phase-to-phase and phase-to-ground clearance parameters are determined in accordance with the NESC, ANSI C2, produced by the American National Standards Institute (ANSI). The NESC provides for minimum distances between the conductors and ground, crossing points of other lines and the transmission support structure and other conductors, and minimum working clearances

[2] A bipole HVDC transmission line consists of two poles – positive and negative. A pole may consist of one conductor or multiple conductors (i.e., sub-conductors) bundled together.
[3] Non-specular finish refers to a “dull” finish rather than a “shiny” finish.

for personnel during energized operation and maintenance activities. The clearance requirements for conductor heights above ground are based on the current and potential use of the land being crossed.

The minimum ground clearance for the TWE Project ±600 kV DC conductor is 37 feet at a conductor temperature of 176°F. For a ±600 kV DC transmission line, the minimum conductor heights will typically range from 37 feet for range lands to 50 feet or more above railroad tracks. Clearances above highways would typically be 40 to 50 feet. Lands with center pivot irrigation or lands that are aerially sprayed would typically use a minimum ground clearance of 37 feet. The exact clearance criteria for each type of land use and each type of facility being crossed will be determined during detailed design.

The clearance requirements for vertical separation at crossings over existing transmission lines are also governed by NESC 2012 Rule 233. In addition to the minimum NESC requirements, additional clearances or buffers are added to account for additional safety, construction tolerances, wire movements, differential wire temperatures, and utility specific requirements. The vertical separation typically ranges from approximately 25 feet for distribution and lower voltage lines to approximately 50 feet or more for 500 kV EHV or high voltage direct current (HVDC) lines. The exact clearance criteria for each voltage class being crossed will be determined during detailed design.

Standard industry practice suggests that the higher voltage line would cross over the lower voltage line. This standard would be followed at the line crossing locations in coordination with each facility owner or manager. To optimize the crossing structure heights, the line crossing locations are typically at mid-spans of the lines being crossed and at right angles to each other. Depending on the terrain and heights of the facility being crossed, taller structures for the TWE Project transmission line may be required at the line crossing locations. Guard structures will be installed, if required, to protect underlying wires and structures during wire stringing operations. These guard structures intercept the wire should it drop below a conventional stringing height, preventing damage to underlying wires and structures. In addition to guard structures, during construction, the Contractor for the TWE Project will be required to coordinate with the owner or operator of the line being crossed to comply with outage and other utility-specific requirements.

Due to the static nature of DC electrical and magnetic fields, the proposed transmission line will not induce any current in oil and gas well heads. The transmission line will be sited such that oil or gas wellheads, and associated above ground facilities at the wellhead, will not be located on the transmission ROW. Additionally, a 250-foot buffer from oil and gas wellheads will be used as a siting criteria for locating the final centerline of the ±600 kV DC transmission line. Section 6.2.2 of this POD provides additional details concerning siting a DC or AC transmission line in proximity to pipelines.

4.1.4 Insulators and Associated Hardware

As shown in Figures 1, 2, and 3, insulator assemblies for ±600 kV DC tangent structures will consist of two strings of insulators normally in the form of a “V.” These insulator strings are used to suspend each conductor bundle (pole) from the structure, maintaining the appropriate electrical clearance between the conductors, the ground, and the structure. The V-shaped configuration of the ±600 kV DC insulators also restrains the conductor so that it will not swing into contact with the structure in high winds. Dead-end insulator assemblies for ±600 kV DC transmission lines will use an I-shaped configuration, which consists of insulators connected horizontally from either a tower dead-end arm or a dead-end pole in the form of an “I.” Individual insulators for both suspension and dead-end applications will be composed of a single unit polymer (non-ceramic insulators).

4.1.5 Overhead Shield (Ground) Wires

Design Characteristics

To protect the ±600 kV DC transmission line from direct lightning strikes, two lightning protection shield wires, also referred to as ground wires, will be installed on the peaks or top arms of each structure. Electrical current from lightning strikes will be transferred through the shield wires and structures into the ground.

Standard Configuration

In the standard configuration (all of the transmission line with the exception of short sections near the terminals where the overhead electrode line connecting the AC/DC converter station to the ground electrode facility is carried in the shield wire position), the shield wires will be composed of two wire types. Neither of these two wire types will have a non-specular finish.

One of the shield wires will be composed of extra high strength steel wire approximately 0.5 inch in diameter. The second shield wire will be an optical ground wire (OPGW) constructed of aluminum and steel, which will carry 36 to 48 glass fibers within its core. The OPGW wire will have a diameter of approximately 0.65 inch. The glass fibers inside the OPGW will facilitate data transfer between the two AC/DC converter stations at the Northern and Southern Terminals. The data will be used for system control and monitoring.

Electrode Line Configuration

In short sections of the transmission line, near the terminals, both shield wires will also serve as the overhead electrode line connecting the AC/DC converter station to the ground electrode facility. The proposed conductor for the overhead electrode line in the shield wire position is a high temperature, low sag conductor approximately 1.0 inches in diameter. The OPGW, described above, will be carried on the structures at a lower elevation between the shield wires and the conductors

4.1.6 Ground Rods

A grounding system, which is distinct from the ground electrode system, will be installed at the base of each transmission tower and will consist of copper ground rods embedded in the ground in immediate proximity to the tower foundation, and connected to the tower by a buried copper lead. After the ground rods have been installed, the grounding will be tested to determine the resistance to ground. If the resistance to ground for a transmission tower is excessive, then counterpoise will be installed to lower the resistance. Counterpoise consists of a bare copper-clad or galvanized-steel cable buried a minimum of 12 inches deep, extending from one or more legs of a tower for approximately 100 feet within the ROW.

4.1.7 Minor Additional Hardware

In addition to the conductors, insulators, and overhead shield wires, other associated hardware will be installed on the structures as part of the insulator assembly to support the conductors and shield wires. This hardware will include clamps, shackles, links, plates, and various other pieces composed of galvanized steel and aluminum.

Other hardware not associated with the transmission of electricity may be installed as part of the Project. This hardware may include aerial marker spheres or aircraft warning lighting as required for the conductors or structures per FAA regulations (FAA 2000, 2007). Tower proximity to airports and tower height are the determinants of whether FAA regulations would apply based on an assessment of wire/tower strike risk. The Applicant does not anticipate that tower lighting will be required because

proposed towers will be less than 200 feet tall and will be located to the greatest extent to avoid airport impacts. However, if special circumstances (e.g., a tall crossing) require structures taller than 200 feet, FAA regulations regarding lighting and marking will be followed.

4.1.8 Grid Interconnections

The TWE Project will need to connect to planned or existing 500 kV and 230 kV transmission grids in Wyoming and to existing 500 kV transmission grids in Nevada, near each terminal. Specific structure types are not known at this time and will be determined during final engineering and design. A typical self-supporting lattice structure, used for a single circuit 500 kV AC line connection, is shown on Figure 5. Typical single circuit and double circuit 230 kV AC single pole structures are shown on Figure 6. The components for the 500 kV and 230 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, are similar to those described for the ±600 kV DC transmission line.

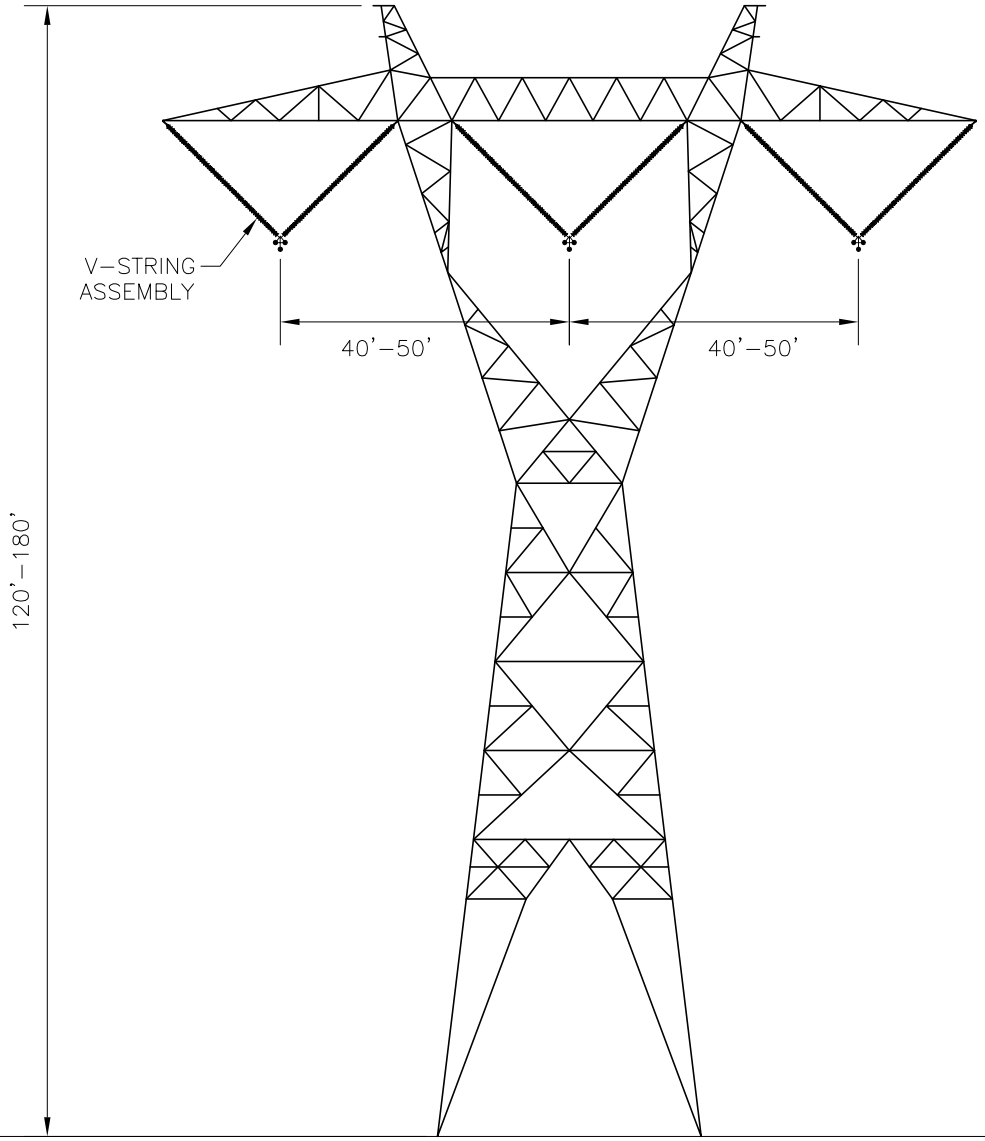

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FIGURE 5

TYPICAL 500kV AC SINGLE CIRCUIT
SELF SUPPORTING
LATTICE STRUCTURE

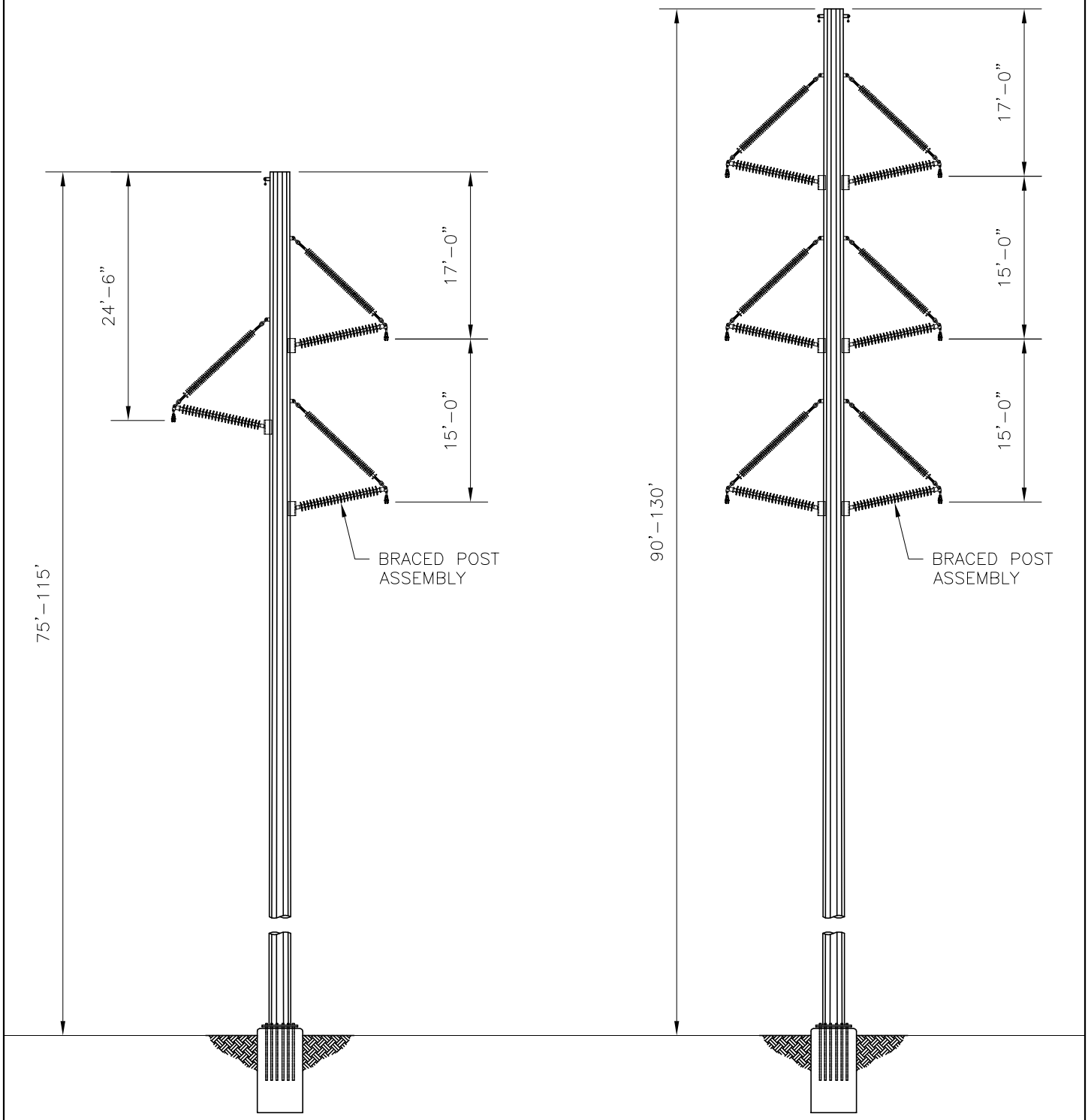

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FIGURE 6

TYPICAL 230kV AC SINGLE & DOUBLE CIRCUIT POLE STRUCTURE

4.2 Northern and Southern Terminals

The terminal stations will be designed to include the AC/DC converter station and an adjacent AC substation. The AC/DC converter station will include a ±600 kV DC switchyard, AC/DC conversion equipment, transformers, and multiple equipment, control, maintenance and administrative buildings. There will be two buildings to house the AC/DC conversion equipment, each approximately 200 feet long by 80 feet wide by 60 to 80 feet high. Additionally, there will be smaller buildings to house the control room, control and protection equipment, auxiliary equipment, and cooling equipment. The AC substations will be either a 500/230 kV substation (Northern Terminal) or a 500 kV substation (Southern Terminal). The AC substations will include a switchyard, transformers, control equipment, and control buildings. Figure 7 is a photograph of a representative AC/DC terminal (converter station and adjacent AC substation).

FIGURE 7 TYPICAL AC/DC CONVERTER STATION

Table 5 summarizes the general design characteristics of the terminals.

TABLE 5 DESIGN CHARACTERISTICS OF TERMINALS

DESCRIPTION OF TERMINALS	
Northern Terminal	Six 500 kV AC line positions, two 500/230 kV transformer banks, twelve 230 kV line positions, two AC filter bank line positions, two reactive support device positions, two DC line positions with transformers, converter building(s), and AC and DC filter yards. The reactive support equipment will require other structures and building development within the proposed complex. Maintenance and storage facilities will be developed as required and as appropriate for this remote location. Certain assigned shift operators, maintenance staff, and site security staff may be on-site at all times, although no permanent residence(s) will be established. On-site fire protection and emergency/security staff will support operations and maintenance staff at the facility in accordance with state, county, and federal requirements.
Southern Terminal	Six 500 kV AC line positions, two 500 kV AC filter line positions, two DC line positions with transformers, converter building(s), and AC and DC filter yards. Maintenance and storage facilities will be developed as required and as appropriate for this remote location. Certain assigned shift operators, maintenance staff, and site security staff may be on site at all times, although no permanent residence(s) will be established. On site fire protection and emergency/security staff will support operations and maintenance staff at the facility in accordance with state, county, and federal requirements.
Physical Properties of Interconnection Lines	
Line Length	Miles per interconnection line
Structure Type	Self supporting lattice for 500 kV line Single pole tubular steel for 230 kV line
Number of Structures per Mile	Approximately six (230 kV structure) and four (500 kV structure)
ROW Width	125 feet for 230 kV line 250 feet for 500 kV line
Land Temporarily Disturbed	
Storage and Concrete Batch Plant	7.5 acres
Structure Work Areas for Interconnection Lines	200 x 200 feet per 230 kV structure; approximately 6 per mile of line (Northern Terminal only) 250 x 200 feet per 500 kV structure; approximately 4 per mile of line
Wire-Pulling, Tensioning and Splicing Sites for Interconnection Lines	ROW width x 500 feet – mid-span conductor and shield wire sites every 9,000 feet and fiber optic set-up sites every 18,000 feet
Land Permanently Disturbed	
Converter Station and Substations	205 acres (N. Terminal), 140 acres (S. Terminal)
Structure Base 500 kV Interconnection Line	Self supporting lattice (tangent) – 1,225 sq. feet (35 x 35 feet tower base) Self supporting lattice (angle) – 1,600 sq. feet (40 x 40 feet tower base) Self supporting lattice (dead-end) – 2,025 sq. feet (45 x 45 feet tower base)
Structure Base 230 kV Interconnection Line	Single pole tubular (tangent) – 40 sq. feet Single pole tubular (angle) – 45 sq. feet Single pole tubular (dead-end) – 50 sq. feet
New Access Roads	See Section 5.2.1: Access Road Construction and Appendix Z Revised Access Road Methodology for FEIS Memorandum (February 2014)

4.2.1 Northern Terminal

The Northern Terminal will consist of an AC/DC converter station (a ±600 kV DC switchyard and a converter building containing power electronics and control equipment), a 500/230 kV AC substation, and a 230 kV AC substation. The facilities will be located on private lands in Carbon County, Wyoming, approximately 2.5 miles southwest of the town of Sinclair, Wyoming. The Northern Terminal will connect to the existing Platte – Point of Rocks 230 kV line located within a mile of the terminal. The Northern Terminal will also connect to the planned Energy Gateway West and Gateway South 500 kV transmission lines being developed by PacifiCorp.

The Northern Terminal will require the following components:

- An AC/DC converter station approximately 30 acres in size.
- A 500/230 kV AC substation approximately 135 acres in size.
- A 230 kV AC substation approximately 40 acres in size.
- An electrical connection from the AC/DC converter station to the ±600 kV DC transmission line connecting to the Southern Terminal. All facilities for this connection are incorporated into the ±600 kV DC transmission line.
- Two electrical connections from the proposed single circuit Energy Gateway West 500 kV transmission line to the 500/230 kV substation. These connections will connect the Northern Terminal to both the Aeolus and Anticline substations via the Energy Gateway West 500 kV transmission line. These two connections may require 500 kV transmission facilities, assumed to be four miles total or less in length, to connect the 500/230 kV substation to the route of the Energy Gateway West 500 kV transmission line. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Two electrical connections from the proposed single circuit Energy Gateway South 500 kV transmission line to the 500/230 kV Substation. These connections will connect the Northern AC/DC converter station to both the Aeolus and Mona Substations via the Energy Gateway South 500 kV transmission line. These two connections may require 500 kV transmission facilities, assumed to be four miles total or less in length, to connect the 500/230 kV substation to the route of the Energy Gateway West 500 kV transmission line. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Two electrical interconnections to the existing Platte – Point of Rocks 230 kV line, which will be rerouted into and out of the 230 kV substation. This 230 kV connection is assumed to require four miles or less of double circuit 230 kV transmission line. Figure 6 shows a typical structure design for the 230 kV transmission line connections.
- Up to six electrical interconnections from proposed and planned generation facilities by 230 kV transmission lines. Figure 6 shows a typical structure design for the 230 kV transmission line connections.

Construction of the Northern Terminal is estimated to require approximately 520 acres. Approximately 250 acres of this area or less will be permanently dedicated for the AC/DC converter station and substations, terminal access road, transmission line structures, and interconnection line access roads. Approximately 205 acres will be fenced for the Northern Terminal. Approximately 275

acres are estimated to be temporarily disturbed for construction work areas, including land for storage and a concrete batch plant, transmission line structure work areas, and pulling, tensioning and splicing sites.

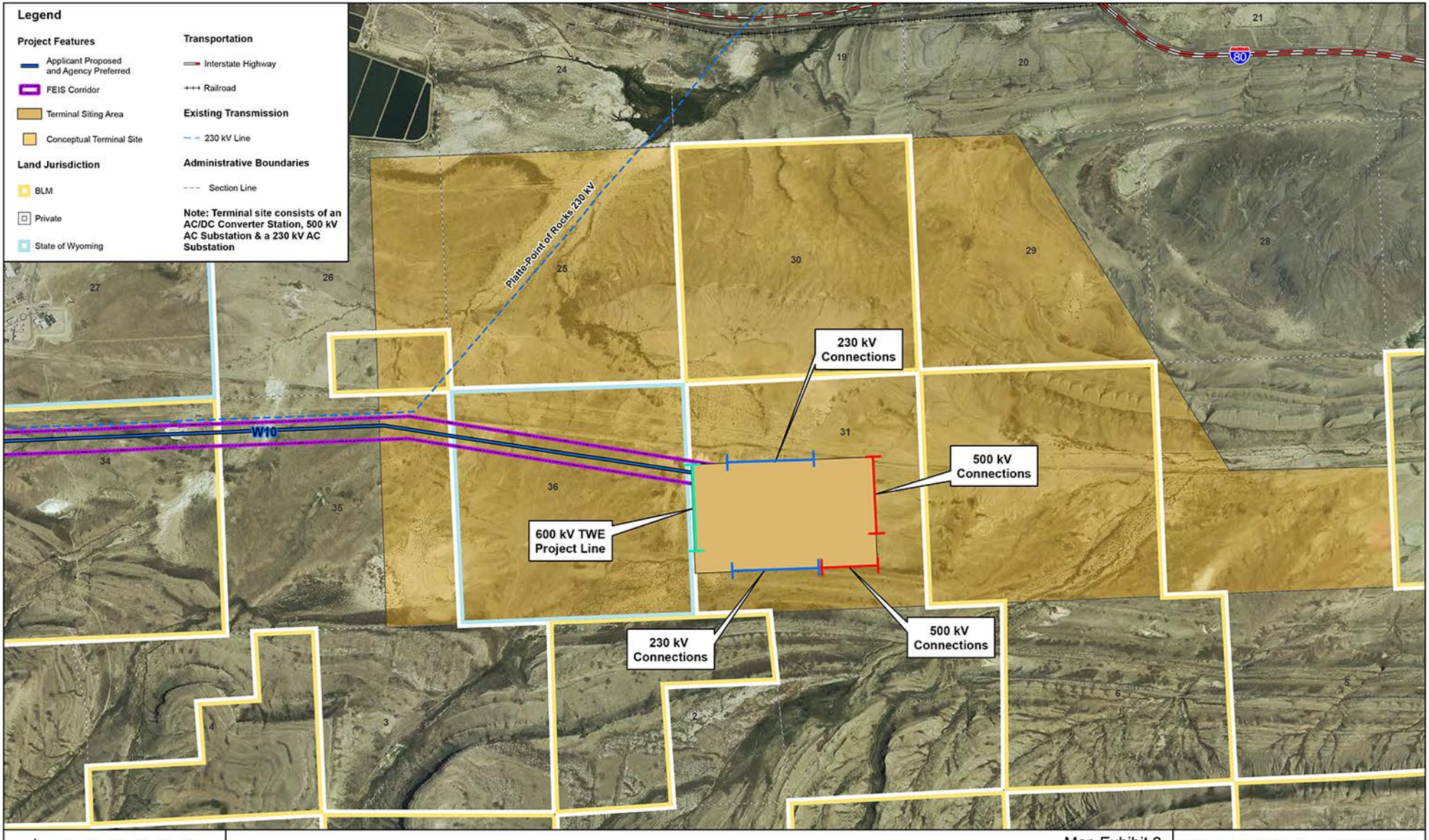
The general planned locations for the Northern Terminal and grid interconnections are shown on Map Exhibit 2. The location for the Northern Terminal site is proposed to be within the siting area shown. The final site location will be determined during final engineering and design. The criteria used in selecting the siting area and the final site location are:

- Land Ownership - use of private lands over public lands is preferable.
- Land Use - other current and planned land uses in the area, in particular other infrastructure that is being planned and permitted.
- Environmental Constraints - avoidance of sensitive resources, including sensitive wildlife habitats, cultural resource sites, wetlands, and major drainages.
- Topography - use of level dry land over more rugged terrain is preferable.
- Access to the TWE Project transmission line corridors coordinated with other existing and planned infrastructure and which minimize line crossings.
- Interconnections with existing, planned, and potential transmission lines such that line crossings are minimized, and conflicts with other existing and planned infrastructure are avoided.

Map Exhibit 2 illustrates a conceptual layout of the Northern Terminal and associated 230 kV and 500 kV connections to existing and planned facilities. The location of the Northern Terminal and the alignments of the 230 kV and 500 kV transmission line connections will be located within the proposed terminal siting area and will be determined during final design.[4]

Based on final ownership/operating agreements and interconnection contracts, it is possible that the 500/230 kV AC substation and/or the 230 kV AC substation could each be broken into two separate facilities. The total required acreage of the separate 500/230 kV AC substation(s) and the 230 kV AC substation(s) would not be greater than the 175 acres (135 plus 40) described above. The total fenced acreage for the Northern Terminal would be 205 acres in either one contiguous facility or 70 acres in one location and an additional 135 acres in a remote location. Land outside of this area would be used for access roads. Terminal access will require an estimated 10 acres of permanent disturbance. With the exception of the associated interconnection lines, no other permanent development outside of the fenced area for this facility is anticipated.

[4] The three major components of the Northern Terminal (AC/DC converter station, 500/230 kV AC substation, and 230 kV AC substation) are planned to be co-located and contiguous. Although each of these three components are stand-alone facilities and could be located on separate parcels connected together by short "transmission" lines, it is common practice and preferable for the AC/DC converter station and 500/230 kV AC substation(s) to be located adjacent to each other. Although it is also preferable to locate the 230 kV AC substation next to the 500 kV AC substation, depending on the availability of space and other constraints in this area, these stand-alone facilities could be separated by a distance of up to two miles.



Map Exhibit 2
Northern Terminal & Grid Interconnections
TransWest Express Transmission Project | May 2014

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4.2.2 Southern Terminal

The Southern Terminal will consist of an AC/DC converter station (a ±600 kV DC switchyard and a converter building containing power electronics and control equipment) and a 500 kV AC substation. The facilities will be located in the Eldorado Valley on private or BLM administered land, approximately 15 miles south of Boulder City, in Clark County, Nevada. The Southern Terminal will connect to all four of the existing 500 kV substations located at the Marketplace Hub. These four substations are the Mead, Eldorado, Marketplace, and McCullough substations.

The Southern Terminal will require the following components:

- An AC/DC converter station approximately 30 acres in size.
- A 500 kV AC substation approximately 110 acres in size.
- An electrical connection from the AC/DC converter station to the ±600 kV DC transmission line connecting to the Southern Terminal. All facilities for this connection are incorporated into the ±600 kV DC transmission line.
- Two electrical connections from the existing Mead – Marketplace 500 kV transmission line to the new 500 kV AC substation. These connections will connect the Southern Terminal to both the Mead and Marketplace substations via the existing Mead – Marketplace 500 kV transmission line. These two connections may require 500 kV transmission facilities, assumed to be five miles total or less in length, to connect the new 500 kV AC substation to the existing Mead – Marketplace 500 kV transmission line. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Construction of a 500 kV transmission line from the new 500 kV AC substation to the Eldorado Substation. This single circuit 500 kV transmission line is estimated to be five miles in length or less. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Construction of a 500 kV transmission line from the new 500 kV AC substation to the McCullough Substation. This single circuit 500 kV transmission line is estimated to be five miles in length or less. Figure 5 shows a typical structure design for the 500 kV transmission line connections.
- Although not anticipated at this time, one or more of the existing 138/230 kV lines within the Proposed Terminal Siting Area may need to be re-routed/re-configured to accommodate the Southern Terminal due to congestion within the area. If necessary, this reroute or reconfiguration of 138/230 kV transmission line facilities is not anticipated to impact more than a total of five miles of line. Figure 6 shows a typical structure design for the 230 kV transmission line connections.

Construction of the Southern Terminal on private land is estimated to require approximately 555 acres whereas the terminal construction on BLM land is estimated to require approximately 750 acres (differences in construction acreages due to lengths of access roads and lengths of 500 kV transmission lines). Approximately 230 to 260 acres of this area will be permanently dedicated for the AC/DC converter station and switchyards, terminal access road, transmission line structures, and interconnection line access roads. Approximately 140 acres will be fenced for the Southern Terminal. Approximately 335 acres on the private land site and 500 acres of the BLM land site are estimated to

be temporarily disturbed for construction work areas, including land for storage and a concrete batch plant, transmission line structure work areas, and pulling, tensioning and splicing sites.

The general planned location for the Southern Terminal and grid interconnections are shown on Map Exhibit 3, which illustrates a conceptual layout of the Southern Terminal and associated 500 kV connections to existing substations. The location of the Southern Terminal and the alignments of the 500 kV transmission line connections will be located within the terminal siting area and will be determined during engineering and design.[5]

Terminal access on the private land site and BLM land site will require an estimated 15 and 20 acres of permanent disturbance, respectively. With the exception of the associated interconnection lines, no other permanent development outside of the fenced area for this facility is anticipated.

4.3 Ground Electrode Facilities

Two ground electrode facilities are proposed, one connecting to the Northern Terminal and one connecting to the Southern Terminal. Table 6 provides the design characteristics of the ground electrode facilities. The proposed site for the northern ground electrode facility is termed 'Bolten Ranch' and shown on Map Exhibit 4. This proposed site is suitable for use with all route alternatives. The three alternative sites shown on Map Exhibit 4 would also connect to the Northern Terminal: Separation Flat, Eight Mile Basin, and Separation Creek.

The proposed site for the southern ground electrode facility is termed 'Mormon Mesa-Carp Elgin Road' and shown on Map Exhibit 5.[6] This proposed site is suitable for use with all route alternatives. The two alternative sites shown on Map Exhibit 5 would also connect to the Southern Terminal: Halfway Wash E. and Halfway Wash-Virgin River.

The proposed and alternative ground electrode sites were selected based on feasibility studies that considered surface and deep earth geology, proximity to the alternative routes, proximity to underground infrastructure (oil, gas and water wells, pipelines, etc.), environmental constraints, and topography. Major factors in selecting the alternative sites were:

1. Geology and ground resistivity of the area. The primary need is for deep sedimentary basins with large volumes of sediment having a low resistivity. Locations with potentially high resistance geologic formations that could potentially interfere with the current path are generally avoided.

2. Distance from grounded metallic infrastructure that might be negatively impacted by DC ground currents. In general, this consideration results in the electrode site being a few miles or more from power plants, electrical substations, underground pipelines, and active oil or gas wells. The ground electrodes cannot be located within two miles of major pipelines due to the risk of having a corrosive impact on nearby metallic structures. Ground electrodes located

[5] The two major components of the Southern Terminal (AC/DC converter station and the 500 kV AC substation) are planned to be co-located and contiguous. Although these two components are stand-alone facilities and could be located on separate parcels connected together by short "transmission" lines, it is common practice and preferable for the AC/DC converter station and 500 kV AC substation to be located adjacent to each other.

[6] Map Exhibits 4 and 5 show both the proposed and alternative ground electrode sites and siting areas

within 2 to 10 miles of major pipelines may require additional or modified corrosion protection systems.

3. Environmental constraints such as special federal and state management areas, sensitive resources (e.g., wetlands), and special status species (e.g., sage-grouse). Secondary consideration was given to topography as it would be impractical to drill the ground wells in mountainous topography.

More detailed information will be required during final engineering and design to make a final determination of the location of the proposed ground electrode sites including: a) availability of public lands or private lands; b) detailed measurements of ground resistivity; c) chemical and thermal characteristics of the soil at the site; and d) a detailed analysis of grounded metallic infrastructures in the area.

TABLE 6 GROUND ELECTRODE FACILITIES DESIGN CHARACTERISTICS

FEATURE	DESCRIPTION
Physical Properties of Overhead Electrode Lines	
Line Length	Miles per electrode line
Structure Type	Wood / wood pole equivalent for low voltage electrode line (similar to 34.5 kV line)
Number of Structures per Mile	18
ROW Width	50 feet
Land Temporarily Disturbed	
Ground Electrode Site	65 acres
Material Storage Yards	10 acres per electrode site
Structure Work Areas for 34.5 kV Line	ROW (50 ft) x 100 feet
Wire-Pulling, Tensioning and Splicing Sites for Interconnection Lines	75 x 150 feet – two at every dead-end 75 x 100 feet – mid-span conductor site every 9,000 feet
Land Permanently Disturbed	
Ground Electrode Site	0.5 acres
Well Access	5 acres
Structure Base Electrode Line (similar to 34.5 kV line)	Wood / wood pole equivalent (tangent) – 16 sq. feet Wood / wood pole equivalent (angle) – 25 sq. feet plus 25 sq. feet per anchor (2 per structure location) Wood / wood pole equivalent (dead-end) – 36 sq. feet plus 25 sq. feet per anchor (4 per structure location)
New Access Roads	See Section 5.2.1: Access Road Construction and Appendix Z Revised Access Road Methodology for FEIS Memorandum (February 2014)

Once construction is completed, approximately 0.5 of an acre, or less, near the center of the electrode containing the control house will be fenced. Agricultural land uses outside the fenced area such as grazing and cultivated crops would be permissible.

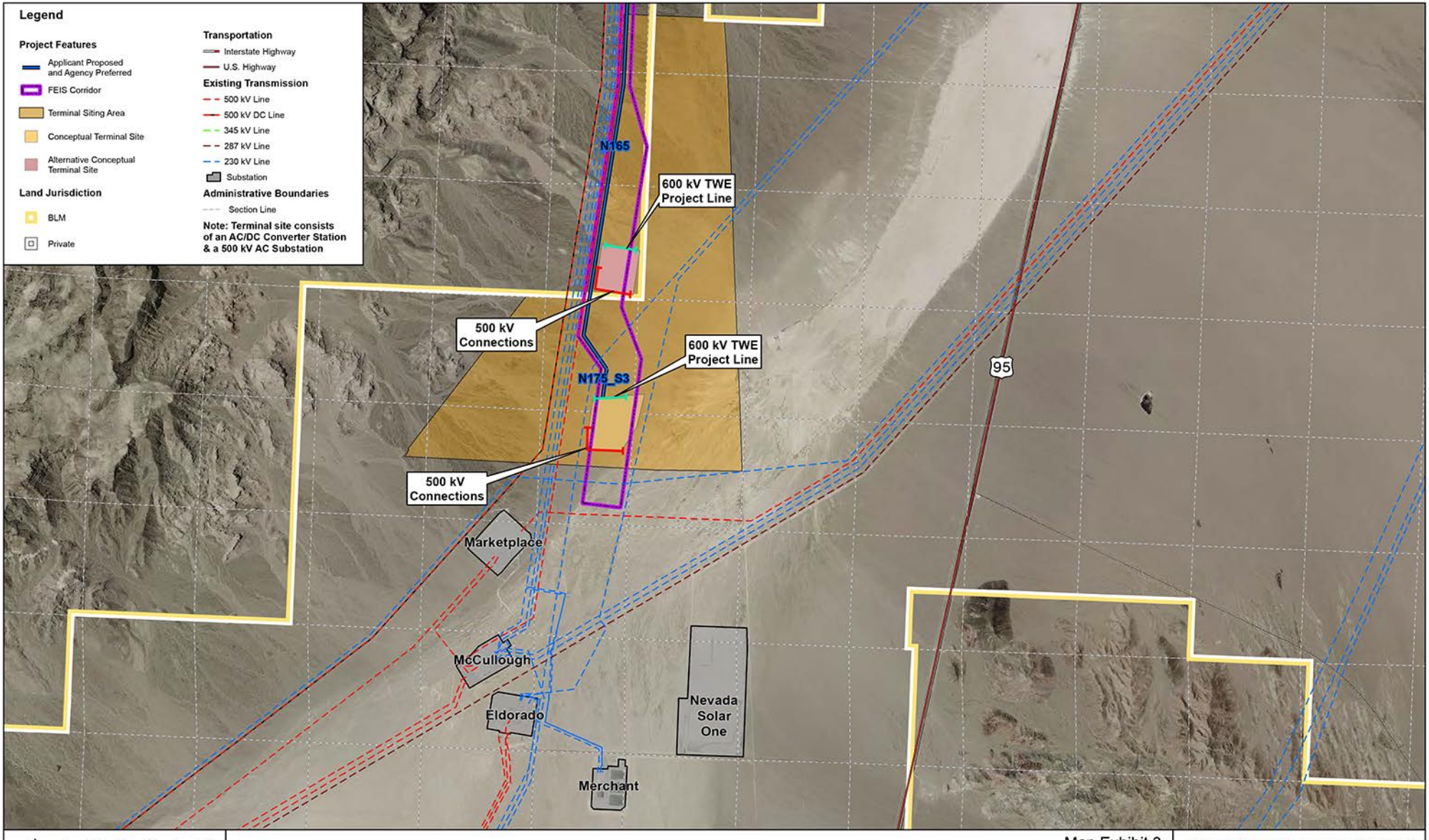
These two ground electrode facilities will be built, each within approximately 100 miles or less of the Northern and Southern Terminals, to establish and maintain electrical current continuity during normal operations and immediately following an unexpected outage of one of the two poles (or circuits) of the ±600 kV DC terminal or converter station equipment.

Each ground electrode facility will consist of a network of approximately 60 deep-earth electrode wells arranged along the perimeter of a circle expected to be about 3,000 feet in diameter. All wells at a site will be electrically interconnected and wired to a small control building via low voltage underground cables. A typical site plan for a ground electrode system is shown in Figure 8 and a photograph of a typical above ground facility is provided in Figure 9.

A low voltage electrode line will be required to connect the ground electrode facilities to the AC/DC converter stations (at the Northern and Southern Terminals). To the extent practical, the overhead electrode line will be co-located on the ±600 kV DC structures in the overhead shield wire position. The overhead electrode line (connecting the terminal to the ground electrode facility) will occupy both shield wire positions from the Southern Terminal to the location where the electrode lines leaves the ±600 kV DC transmission line. Figure 10 shows a typical structure with the electrode line in the shield wire position with the fiber optic line (OPGW) located between the shield wires and the DC conductors. Where the electrode line diverges from the ±600 kV DC transmission line, it will be located on single pole structures, similar to those used for a modified 34.5 kV subtransmission line, built within a separate 50-foot-wide ROW. The electrode line will consist of two, high temperature, high capacity conductors. Figure 11 shows a typical single pole structure design that would be used for the overhead electrode line.

During a DC transmission disturbance where one pole (or "circuit") becomes inoperable, the ground electrodes will carry a short-term large current that was previously flowing in the inoperable pole. The electrodes will be sized and designed to disperse this current into the ground at levels which are safe for people and animals in the vicinity. Such contingency conditions that result in high ground electrode currents are most often the result of an unexpected outage on the transmission line or equipment in the AC/DC converter station. The high current operation of the ground electrode facilities and the use of the earth as a return path is limited to unexpected emergency conditions and typically only operated for 10 minutes to less than an hour following the loss of a pole. For planning and preliminary engineering purposes, 12 to 16 unexpected disturbances resulting in the loss of a pole are anticipated on a yearly basis. Although the ground electrode facilities will be designed to operate at high current levels for up to 200 hours per year, typical yearly use at high currents is expected to be less than 30 hours per year.

The use of these ground electrode facilities allows system operators to maintain a portion of the TWE Project's power transmission capacity to support power network reliability. This feature will allow critical time for network operators to determine the extent of the electrical disturbance and reconfigure the transmission and generation systems into a more stable configuration that minimizes disruption of customer loads.



0 0.25 0.5 0.75 1 1.25
Miles

Map Exhibit 3
Southern Terminal & Grid Interconnections
TransWest Express Transmission Project | May 2014

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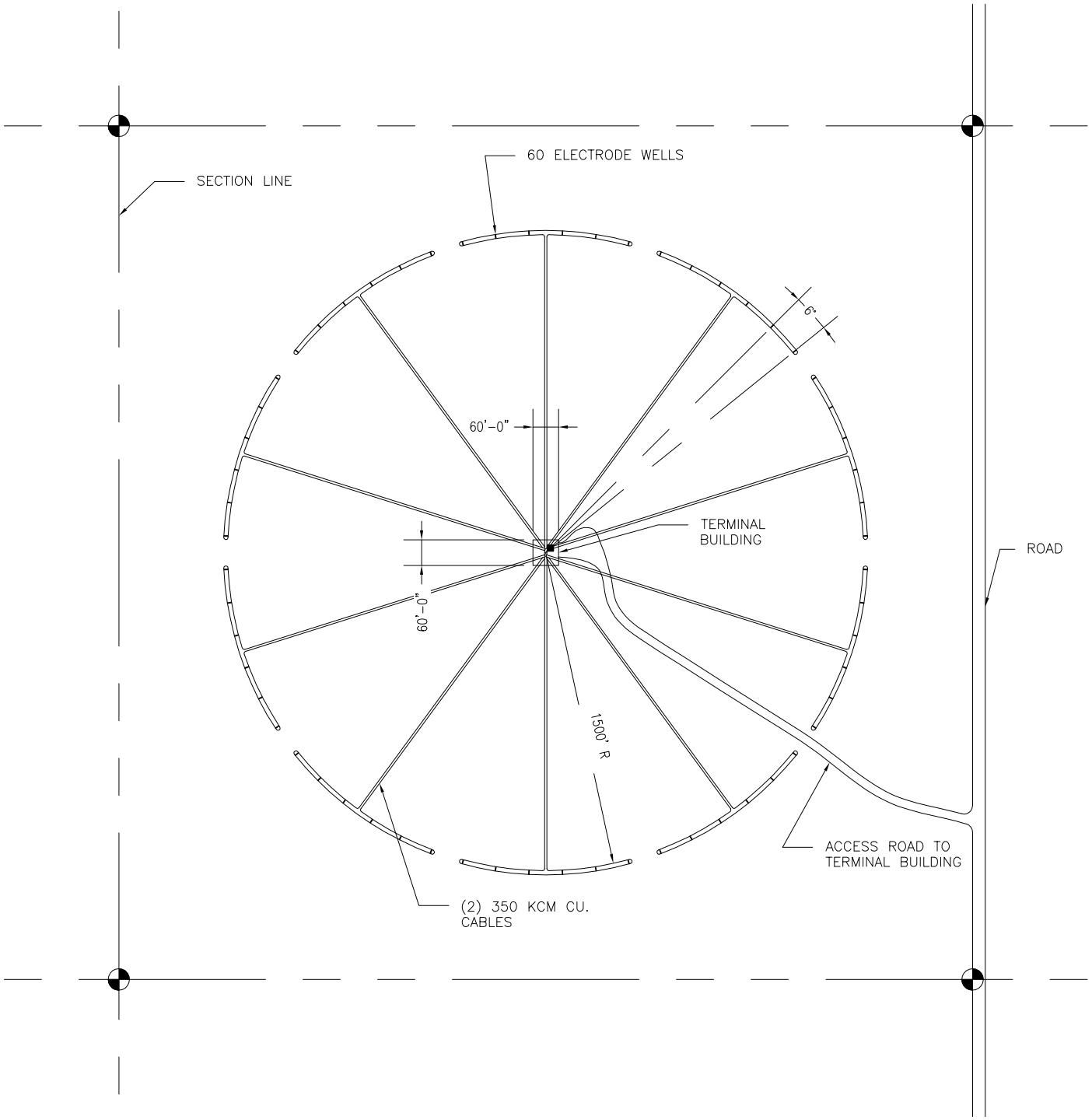

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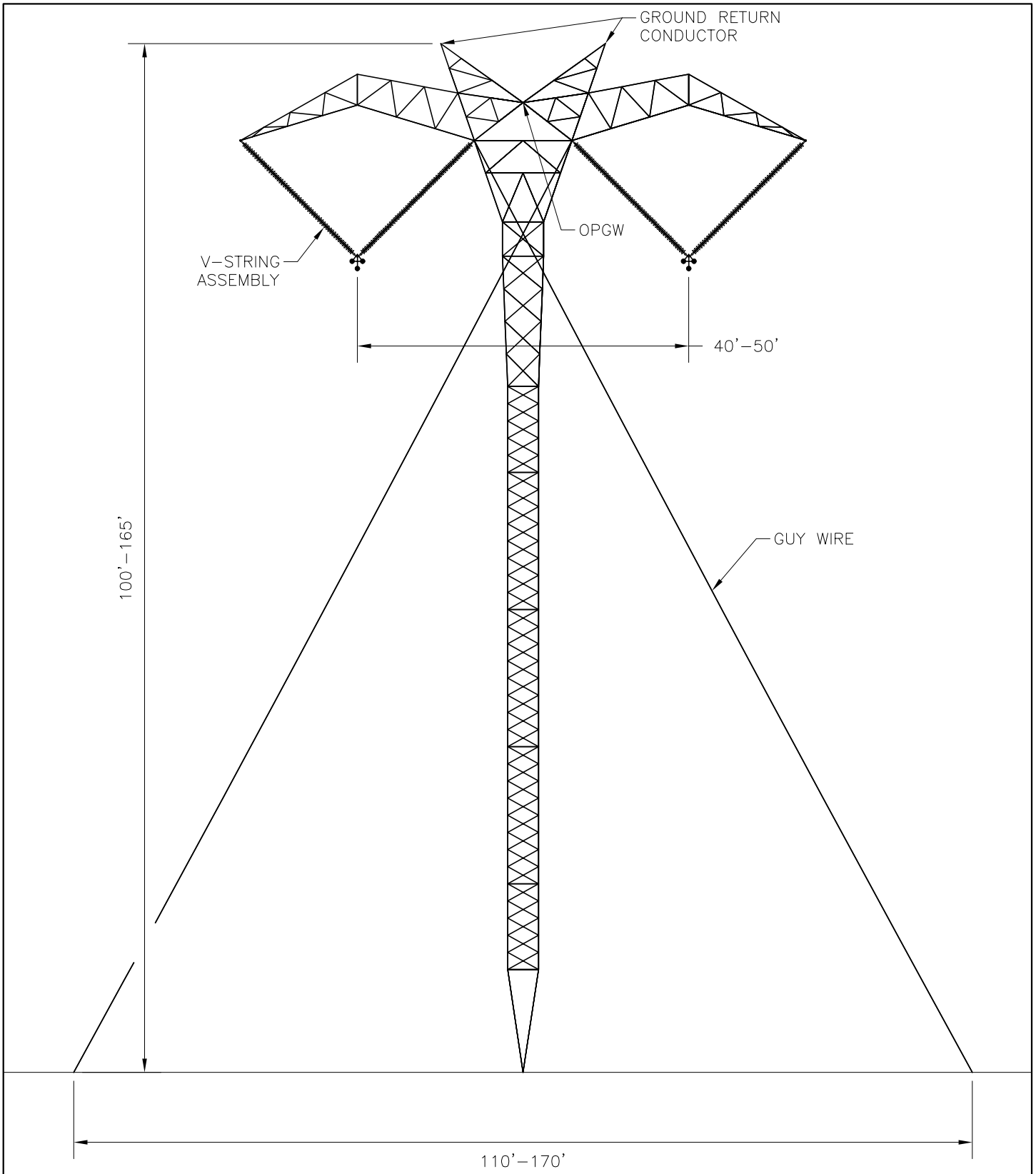
FIGURE 8

TYPICAL SITE PLAN FOR
GROUND ELECTRODE SYSTEM

FIGURE 9 TYPICAL ABOVE GROUND CONSTRUCTION AT THE GROUND ELECTRODE FACILITY



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.
2. TOWER OUTLINE AND BRACINGS ARE INDICATIVE ONLY.

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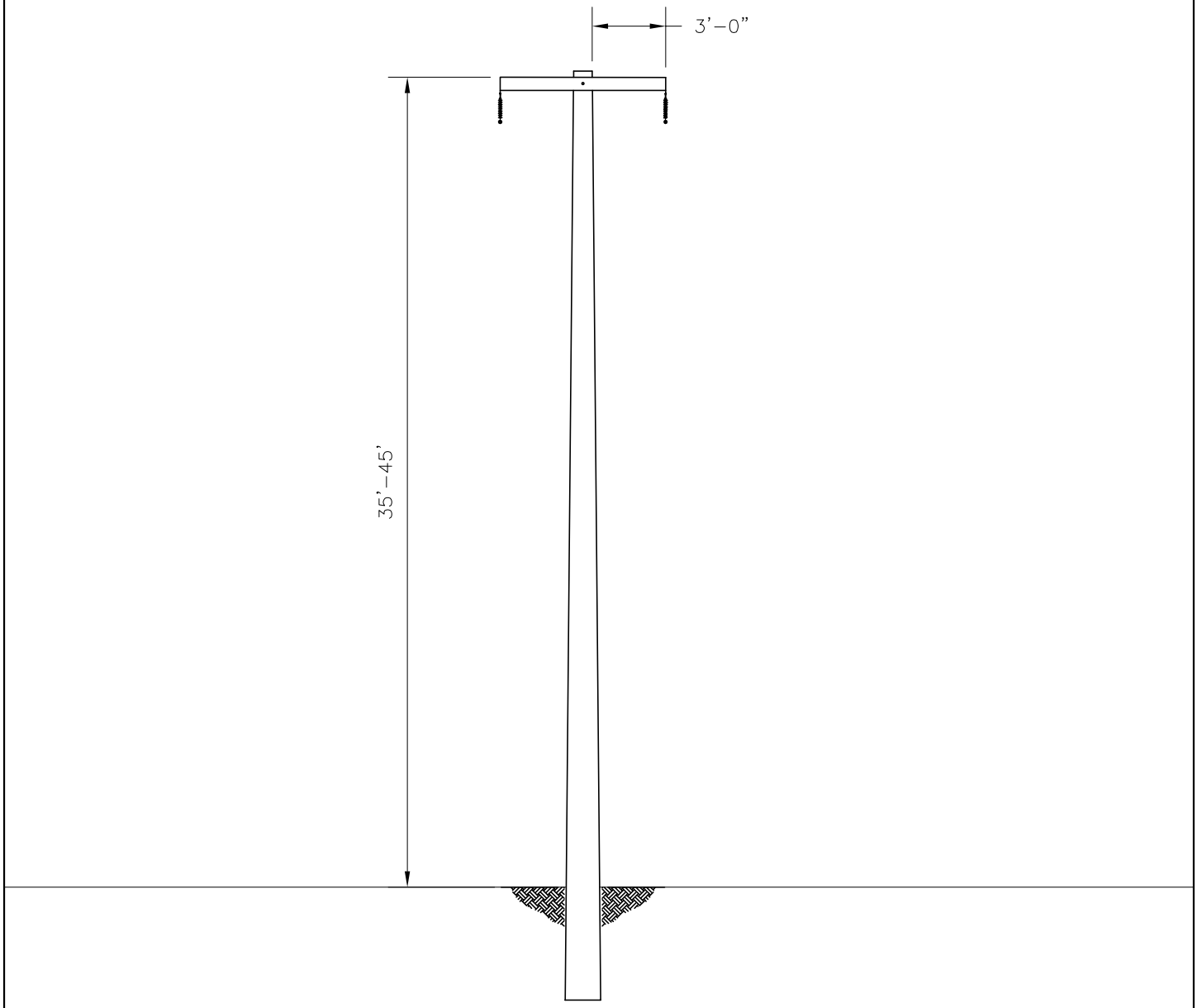
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 10

CO-LOCATED GROUND ELECTRODE LINE
ON GUYED LATTICE STRUCTURE



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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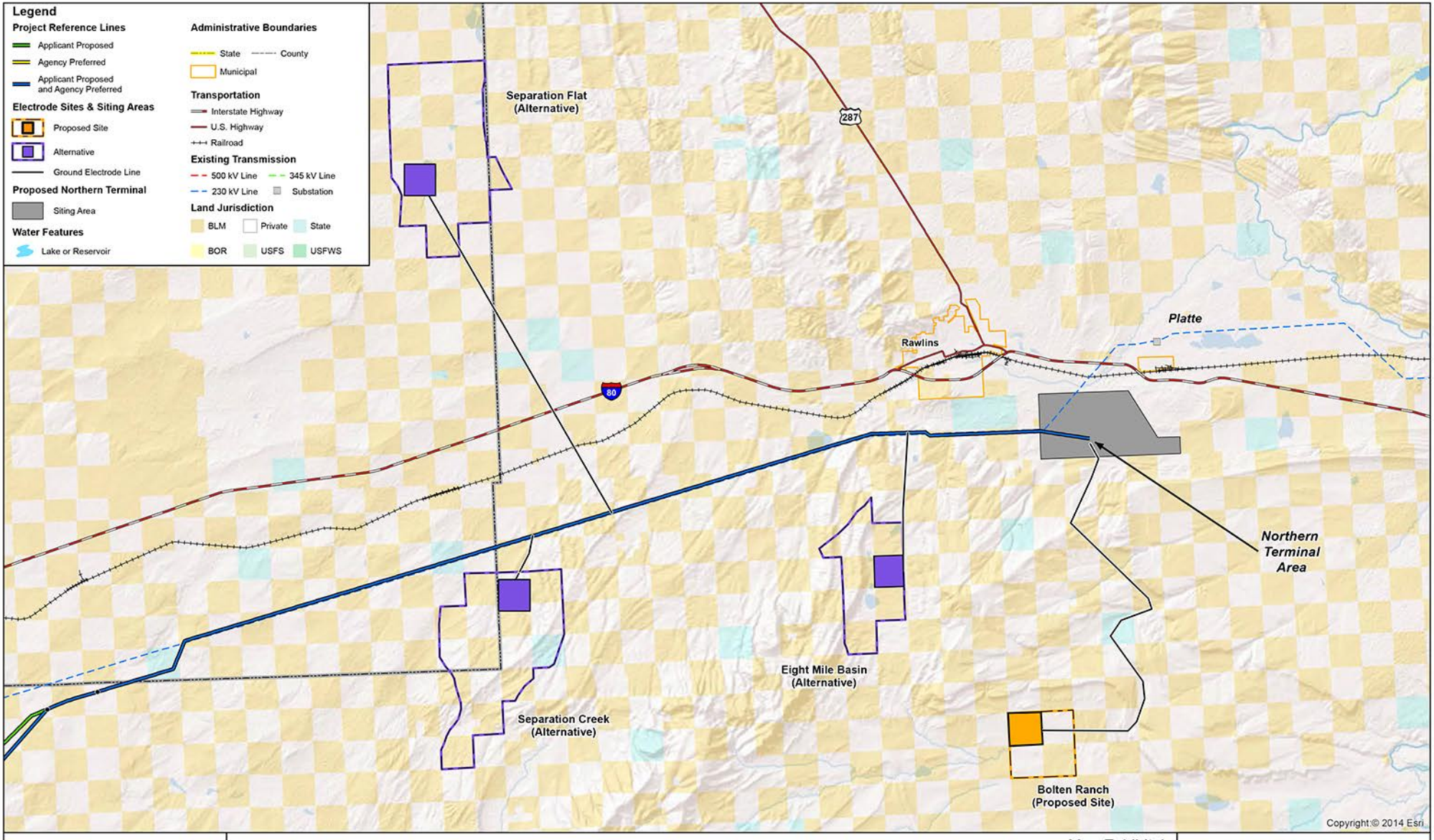
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 11

TYPICAL POLE STRUCTURE FOR OVERHEAD ELECTRODE LINE



0 0.9 1.8 2.7 3.6 4.5
Miles

Map Exhibit 4
Northern Terminal and Ground Electrode Facility - Proposed and Alternative Sites and Siting Areas
TransWest Express Transmission Project | May 2014

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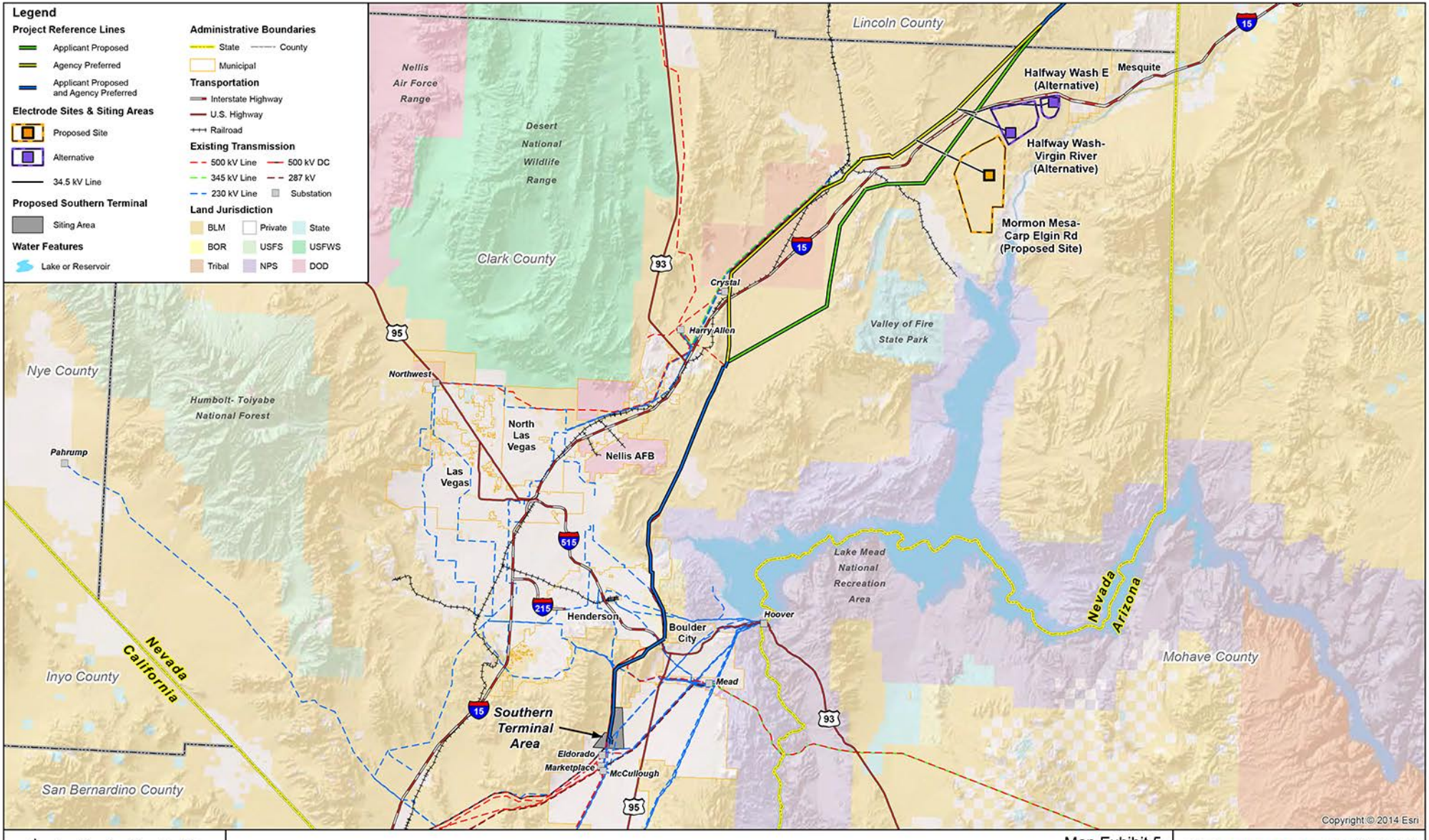

Map Exhibit 5

Southern Terminal and Ground Electrode Facility- Proposed and Alternative Sites and Siting Areas

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4.4 Communications Systems

The TWE Project will require a number of critical telecommunications support subsystems. These systems will be configured and designed to support the overall availability and reliability requirements for the operation of the HVDC terminal facilities and supporting substations. To provide secure and reliable communications for the control system real-time requirements, protection and day-to-day operations and maintenance needs, a mix of telecommunications systems will be used. The primary communications for protection and control will be provided via the one OPGW installed in the shield wire position on the transmission line. For redundancy purposes, a secondary communications path will be provided via existing or expanded/upgraded microwave systems or existing alternate buried fiber paths in the TWE Project region.

In addition to protection and control, the communications system will be used for Supervisory Control and Data Acquisition (SCADA). The SCADA system is a computer system for gathering and analyzing real time data which is used to monitor and control the substation (e.g., transformers and transmission lines), and auxiliary (e.g., pumps and cooling systems) equipment. A SCADA system gathers information, such as the status of a transmission line, transfers the information back to a central site, alerting the central site that the line has opened, carrying out necessary analysis and control, such as determining if outage of the line is critical, and displaying the information in a logical and organized fashion.

The primary communications will be an all-digital fiber system with repeater/regeneration facilities utilizing the OPGW located on the transmission line structures. The optical data signal degrades with distance as it travels through the optical fiber cable. Consequently, signal regeneration sites are required to amplify the signals if the distance between stations or regeneration sites exceeds approximately 50 miles. In total, approximately 15 to 20 regeneration sites will be required for the proposed TWE Project. In most cases, the regeneration communication sites will be located within the transmission line ROW and will typically be 100 feet by 100 feet or less in size. Figure 12 shows a typical communications regeneration site.

The secondary communications path for the TWE Project will be provided either by a private Project microwave system or purchasing/leasing capacity on existing utility dedicated communication networks within the TWE Project region.

If required, a private microwave system will be structured to utilize existing developed communications sites, access roads and utility held sites to the maximum extent possible. A small number of new microwave sites may be required for the TWE Project. As a microwave system requires line-of-site communications, the number and location of microwave sites, if needed, will be determined during final design and engineering. A typical microwave communication site is less than 100 feet by 100 feet, and consists of a fenced enclosure that contains a small building for the communications equipment and a tower for mounting the microwave antenna(s). The microwave tower may be 50 feet to 150 feet high to meet the line-of-site communications requirement. In addition, multiple antennas may be mounted on the microwave tower depending upon the communications needs. In some cases, such as very remote locations with limited access to a reliable power supply, a small back-up generator may be required.

To facilitate mobile communications along the transmission line route for transmission line patrol, inspection, routine maintenance and emergency operations, a mobile ultra-high frequency (UHF)/very high frequency (VHF) radio communications system will be implemented. For planning purposes, UHF/VHF radio equipment, towers, antennae and repeaters are assumed to be installed at each regeneration station.

FIGURE 12 COMMUNICATIONS REGENERATION SITE

5.0 CONSTRUCTION

This section describes the construction practices that will be used for the TWE Project, including the ± 600 kV DC transmission line; terminals; ground electrode facilities; and communication systems. Construction activities are described in the following sections:

- Section 5.1 – Pre-construction activities to be completed prior to construction commencing.
- Section 5.2 – Construction activities for the + 600 kV DC transmission line and associated access roads.
- Section 5.3 – Construction activities for the northern and southern terminals.
- Section 5.4 – Construction activities for the ground electrodes.
- Section 5.5 – Construction activities for the communications system.
- Section 5.6 – Post-construction clean up and restoration.
- Section 5.7 – Special construction methods to be used in specific sensitive locations, including blasting and helicopter construction techniques; roadless construction methods in IRAs; construction techniques applicable to sensitive water resource areas; and water use during construction.
- Section 5.8 – TWE Project construction schedules, manpower, and equipment requirements.

Construction of the TWE Project will require surface access to all structures and work areas during construction and operation of the Project to allow construction vehicles and equipment to access the location of each transmission structure or Project facility. In most cases, existing public roads (identified as the backbone access network) would be used to transport construction labor, equipment and materials to the approved work areas.

Although the number of construction vehicles needed for the Project is not expected to substantially increase traffic volumes, the delivery of large pieces of equipment or material as part of the construction process may slow or interrupt traffic on state or county roads on a short-term basis. The duration of these types of traffic disruption are typically very short, a few minutes or less while the delivery truck passes down a roadway or turns a corner. The limited number of large pieces of equipment or material that are delivered to any one portion of the Project tends to make traffic disruptions infrequent and generally unnoticed by the motoring public. Additionally, short-term traffic diversions and brief road closures (if needed) may be required to complete wire stringing activities. All traffic impacts resulting from any construction activities including short-term traffic diversions, traffic congestion, traffic warning systems and brief road closures (if needed) will comply with the Traffic and Transportation Management Plan (Appendix U).

5.1 Pre-Construction Activities

Prior to construction, the Applicant will obtain all applicable federal, state, and local permits; acquire easements and ROW grants for the TWE Project facilities; conduct geotechnical surveys and testing; and conduct pre-construction engineering and environmental surveys.

5.1.1 Permitting

The Applicant will acquire all federal, state, and local permits, licenses and agreements. A list of potential applicable permit requirements has been provided through the NEPA process and incorporated into this POD (see Section 1). The TWE Project will necessitate crossings of existing electrical transmission lines, U.S. and State Highways, and railroads. The proposed line crossings will be coordinated with the appropriate entity and TransWest will obtain all required licenses, permits, or agreements.

5.1.2 ROW and Property Rights Acquisition

The acquisition of ROW or properties necessary to construct, operate, and maintain the TWE Project will be completed by Western or the Applicant conditioned on Western's continued involvement in the TWE Project. New ROW will be acquired for the transmission line(s) through a combination of ROW grants and easements with various federal, state, and local governments; other companies (e.g., utilities and railroads); and private landowners.

Property owners affected by the TWE Project would initially be contacted by a realty agent who would explain the steps involved in site selection, property rights acquisition, and construction. A realty agent would request permission (for workers or Contractors) to enter the property to conduct engineering and environmental surveys and studies. Landowners will be contacted early in the process to obtain right-of-entry for surveys. Each landowner along the final centerline route will be contacted to explain the Project and to secure right-of-entry and access to the ROW.

Studies will be conducted to select structure sites, based on engineering design criteria, terrain, geologic investigations, and property owner input regarding land use and how to minimize potential impacts to properties. Geotechnical drilling will be required at some sites. Property owners will be compensated for damages to crops, fences, and other property caused by surveys and studies.

Property rights, in the form of perpetual easements or ROW, will be needed to construct, operate, and maintain the transmission line. Land for the terminals, substations, series compensation (as may be required for Design Options 2 and 3; see Section 7.0), and communication regeneration stations will be obtained in fee simple where located on private land. Easements and fee simple properties will be purchased through negotiations with landowners based on independent appraisals. Independent appraisals are used to determine the fair market value of the easement or property. Every effort will be made to acquire easements and properties through landowner negotiations to obtain an agreement, which is fair and reasonable to both parties. For transmission line easements, the landowner will retain title to the land and may continue to use the property in ways that are compatible with the transmission line.

To the extent that Western acquires land for the TWE Project, Western will do so in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

Federal and state laws enable public agencies, and in some cases private parties, to acquire property rights for facilities to be built in the public interest. If a negotiated agreement cannot be reached, easements can be acquired through eminent domain (condemnation) proceedings. Through the eminent domain process, a court determines the compensation to be paid to the property owner(s).

5.1.3 Geotechnical Surveys and Testing

Prior to construction of the TWE Project, ground-based land surveys will be required at soil boring locations required for geotechnical investigations. These ground-based land surveys will include

staking of the boring location and layout and staking (as needed) of access roads to the boring locations.

A desktop study will initially be conducted to identify geologic hazards. Specifically, the desktop study will research available published data related to soils, expansive soils, mapped bedrock, surficial geology, corrosivity, faulting and folding, seismicity and earthquakes, surface and groundwater, flood areas and hazards, landslides, rock fall hazards, subsidence, liquefiable soils and wells. The desktop study will be used for preliminary engineering designs.

Field geological and geotechnical studies will reference the desktop study to prepare the appropriate exploration programs given the planned structure locations, foundation loading, access, and geologic setting. The proposed studies will be performed to evaluate potential geologic and geotechnical hazards and to determine specific requirements (soil/rock types, depth to rock, depth to groundwater, soil strength properties, etc.) for foundation design and construction. These studies will be used for final engineering designs necessary for construction.

Geological evaluation will occur at generally the same time as geotechnical investigations, and will be a part of the final Geotechnical Plan. The framework Geotechnical Plan is provided in Appendix J. For this activity, an engineering geologist will evaluate fault lines, landslide prone areas, steep slopes, and unstable soils to identify potential hazards, primarily at structure sites. Geologic review and evaluation will also be performed in the immediate vicinity of structure sites, and for access roads crossing steep slopes and unstable soils. The primary purpose of the geologic evaluation is to identify potential hazards with sufficient lead time to evaluate options for avoiding or mitigating potential hazards. The Project geotechnical engineer and geologist will prepare a report including recommendations for any necessary relocation of structure sites or access roads in potentially hazardous areas. In the event that a structure site cannot be relocated, the Geotechnical Plan will also specify construction methods designed to stabilize the site as well as any adjacent areas that might pose a hazard to the main site. Initial recommendations will be incorporated into the ROD POD and final recommendations incorporated into the NTP POD, including construction details for grading, drainage, and specialized slope treatments. The Contractor will implement the plans. All geologic/geotechnical field studies required will be coordinated with the appropriate land management agencies or private landowner and the appropriate permits will be obtained by the Applicant.

To determine foundation design requirements, geotechnical investigations will be performed in the field to evaluate site conditions and determine the soil/rock type, strength and design properties. This study will entail a geotechnical drilling program at select structure locations along the selected Alternative. At sampling sites, borings will be performed from which soil and/or bedrock material samples will be taken for laboratory testing and analysis. Soil borings are typically six to eight inches in diameter and as much as 70 feet deep and they will be advanced with continuous flight hollow-stem auger, mud rotary, or ODEX drilling techniques. Where bedrock is encountered, standard rock coring techniques will be used. Soil borings are commonly taken at structure site locations at intervals of approximately one mile and at PIs (Points of Intersection/Inflection).

Soil borings will be performed with rubber tired, track or low impact drill rigs using approved access routes and methods in accordance with the appropriate land management agency or private landowner requirements with applicable mitigation measures applied. Equipment typically used for geotechnical evaluations includes a drill rig, water truck, and 4-wheel drive support vehicles. The average estimated drilling time at each site is approximately one-half day. Work areas are typically 40 feet by 40 feet in size (1,600 square feet/0.37 acre) with the disturbed area contained approximately within a 5 feet diameter circle.

Small surface disturbances may occur at the structure site drill locations caused by parking, use of equipment, and associated field crew activities in the work area. Water may be used during the drilling process and a very small amount of water may exit the drill holes. Following the completion of drilling and before leaving each site, the soil boring will be backfilled with the cuttings removed from it during drilling per the appropriate federal agency requirements. Excess spoils not backfilled into the bore hole will be removed from the site and disposed of in accordance with the appropriate land management agency or private landowner requirements with applicable mitigation measures applied. No open holes will be left unattended, and all holes will be fully backfilled before moving to the next boring.

Ground disturbance from geotechnical investigations would occur within the structure work areas and would not cause additional disturbance. Access roads used for geotechnical investigations would be the same as those used to access structures for construction. Although none is anticipated, any additional ground disturbance from geotechnical investigations on federal lands prior to the issuance of the TWE Project ROW grants may require additional authorizations. The Applicant will apply for and obtain all necessary federal, state, and local authorizations.

5.1.4 Pre-Construction Surveys

Pre-construction engineering surveys will be conducted to identify the transmission line ROW centerline and width, structure sites, vegetation clearance boundaries, property boundaries, ground profiles, access routes, temporary work areas, and stream crossings. Access for engineering surveys will be with 4-wheel drive and all terrain vehicle (ATV) type vehicles using existing roads. All off-road access will be by low-impact rubber-tired ATV or on foot depending upon terrain and vegetation and in accordance with the appropriate land management agency or private landowner requirements with applicable mitigation measures applied.

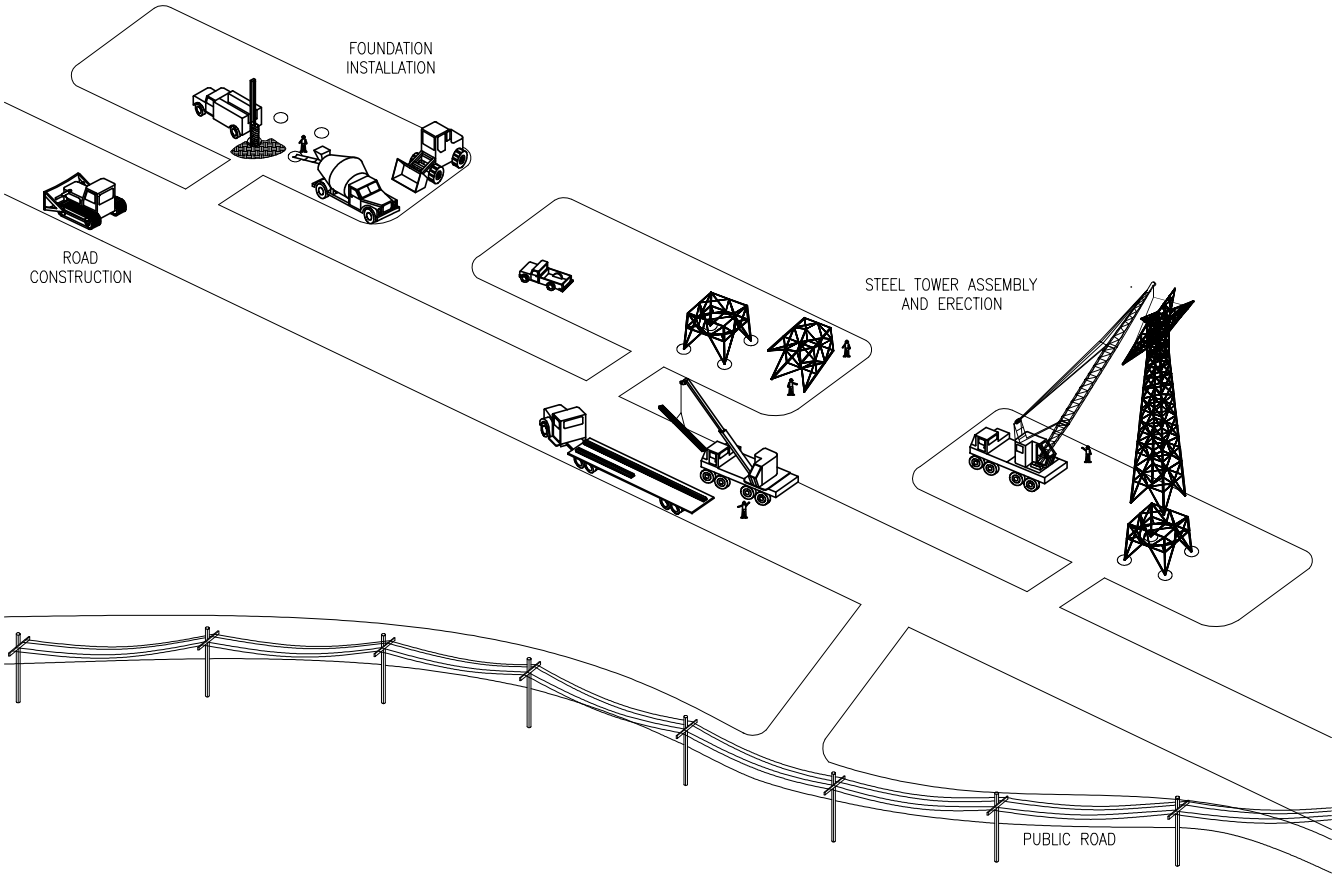
Pre-construction environmental surveys will be conducted, as required by permitting agencies, for the identification, flagging, and avoidance of sensitive resources. The timing of pre-construction surveys will vary depending upon the resource being surveyed. Requirements for environmental pre-construction surveys will be documented in the FEIS and the regulatory agencies' decision documents and stipulations. Documents currently under development which may identify additional biological and cultural pre-construction surveys include the Biological Assessment/Biological Opinion (BA/BO) and the PA, respectively. Pre-construction environmental surveys may include, but are not limited to: (1) migratory bird and raptor nest surveys; (2) special status wildlife and botanical species, including those protected by USFWS, BLM, USFS, and respective state resource management agencies; (3) noxious weed identification; (4) cultural resource surveys; (5) paleontological resource survey, and (6) wetlands delineations in accordance with requirements of the Clean Water Act (CWA) Section 404 permit.

The following appendices in this POD provide details of required pre-construction surveys:

- Avian Protection Plan (Appendix B);
- Cultural Resources Protection and Management Measures Plan (Appendix D);
- Noxious Weed Management Plan (Appendix N);
- Paleontological Resources Management and Mitigation Plan (Appendix P);
- Water Resources Protection Plan (Appendix W); and
- Wildlife and Plant Conservation Measures Plan (Appendix X).

5.2 Transmission Line Construction

The following sections detail the transmission line construction activities associated with the proposed ±600 kV DC transmission line and access roads. The general sequence of transmission line construction includes: construction of access roads; clearing of ROW and temporary work areas; installation of foundations; assembly and erection of structures; installing ground rods/counterpoise; installing shield wires and conductors; and site cleanup and reclamation. Typical transmission line construction activities and sequencing are depicted in Figures 13 and 14. Various construction activities will occur during the construction process, with several construction crews operating simultaneously at different locations. Section 5.8.3 summarizes the types and quantities of equipment to be used for the transmission line construction.



TYPICAL TRANSMISSION LINE CONSTRUCTION ACTIVITIES

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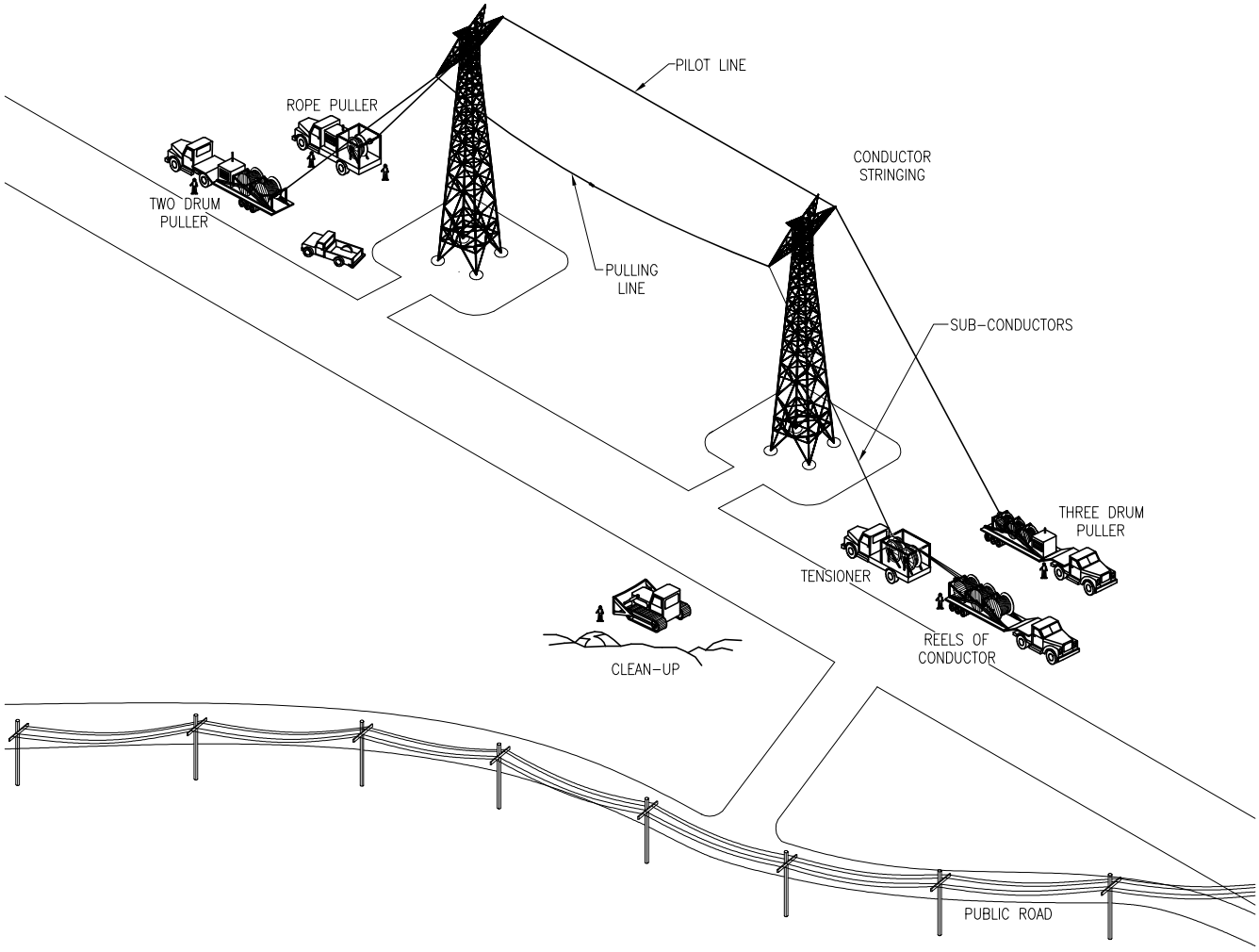
FIGURE 13

STRUCTURE FOUNDATION INSTALLATION,
TOWER ASSEMBLY, &
ERECTION ACTIVITIES



BASIC WIRE HANDLING EQUIPMENT
SINGLE CIRCUIT TOWER

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 14
CONDUCTOR STRINGING ACTIVITIES

5.2.1 Access Road Construction

Access roads are an essential part of the construction and operation of the TWE Project. As such, the TWE Project will require surface access to all structures and work areas during construction and operation to allow construction vehicles and equipment to access the location of each transmission structure and Project facility. Access roads constructed as part of the Project but not required for operations will be restored to their original condition or left as-is per the appropriate land management agency or private landowner requirements. Access in Inventoried Roadless Areas (IRAs) is discussed in Section 5.7.3 Roadless Construction. The TWE Project has been designed to utilize existing access roads wherever practicable in order to minimize environmental impacts associated with new road construction.

Table 7 summarizes typical road requirements for construction and routine and non-routine operations.

TABLE 7 TYPICAL ROAD REQUIREMENTS FOR TRANSMISSION LINE SYSTEM

ROAD TYPE	ACCESS ROADS FOR CONSTRUCTION	ACCESS ROADS FOR ROUTINE OPERATIONS	ACCESS ROADS FOR NON-ROUTINE OPERATIONS USE
Existing Improved Roads	No change	No change	No change
Existing Roads Needing Improvement	Unsurfaced - use as-is with improvements as needed throughout construction	For routine activities, an 8-foot portion of the road will be used and vehicles will drive over the vegetation ("two-track").	For non-routine maintenance requiring access by larger vehicles, the full width of the access road may be used. Roads will be repaired, as necessary, but will not be routinely graded. In order to preserve the ability to enter rapidly, the road structure (cuts and fills) will be left in place.
New roads	Unsurfaced – "drive and crush", "clear and cut" or bladed roads as required by terrain, use, local conditions, regulatory requirements, etc.	For routine activities, an 8-foot portion of the road will be used and vehicles will drive over the vegetation ("two-track").	
Temporary Roads (roads constructed to access temporary work areas)	Unsurfaced – similar treatment to new roads	None—contours will be restored, and the road will be ripped and seeded.	None

Existing roads will be used to access work areas whenever practicable. Two types of existing roads are "Existing Improved Roads" and "Existing Roads Needing Improvement". "Existing Improved Roads" are roads that appear to either be hard-surfaced roads or have well maintained surfaces. No improvement or maintenance of "Existing Improved Roads" is anticipated as a result of TWE Project construction. "Existing Roads Needing Improvement" will have varied conditions across the Project and include trails, two-track roads, and non-maintained dirt roads. It is anticipated that the Contractor may need to perform some level of improvement to provide the safe travel way required for construction. Based on the Contractor's construction plan and the construction techniques employed, it is anticipated that sections of the access roads classified as "Existing Roads Needing Improvement" will receive one of the following treatments.

- The existing road will be sufficient and provide a safe travel way throughout the duration of Project construction.

- The existing road will be sufficient and provide a safe travel way during a portion of the line construction period. Weather events, progressive damage due to heavy use and larger heavier equipment needed are examples of reasons that an existing road would need some level of construction at one or more intermediate points during line construction.

- The existing road at project initiation needs more extensive construction, including blading, prior to the start of line construction.

- Portions of these roads will involve "clear and cut", or "drive and crush".

The construction of new access roads will be required only as necessary to access structure sites lacking direct access from existing roads, or where topographic conditions (e.g., steep terrain, rocky outcrops, and drainages) prohibit safe overland access to the site. A new access road refers to implementing all activities required to establish a travel-way that allows vehicular access from an existing road to the required work location and does not imply construction of a new road with a ditch and raised shoulder. Where terrain and soil conditions are suitable, non-graded overland access ("drive and crush") will be utilized. New access roads will be located within the ROW whenever practical and will be sited to minimize potential environmental impacts. The number of new access roads will be held to a minimum, consistent with their intended use (e.g., access to structure work areas or wire-pulling and tensioning sites).

Where new roads are required or where improvements to existing roads are required, access roads will be designed in accordance with standards and guidelines for Non-constructed Roads and Routes as described in "The Gold Book – Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development" (AASHTO 2006). Portions of the access road network requiring design and construction to a more stringent standard will be identified in the Access Road Siting and Management Plan submitted with the NTP POD.

An Access Road Siting and Management Plan will be developed for the selected Alternative during final engineering and design, which will define site-specific access to each structure and work area. A framework Access Road Siting and Management Plan is provided in Appendix A.

Prior to finalizing access road locations during final engineering and design, a methodology was developed to estimate the miles of access roads and to ultimately approximate the area of potential ground disturbance associated with access roads to be used in the EIS analysis. This methodology is described in detail in the Revised Access Road Methodology for the FEIS Memorandum (February 2014) provided in Appendix Z. Table 8 summarizes the access road categories used to estimate access road requirements by greenfield vs. co-located route segments for different terrain types and for roads inside and outside of the proposed right-of-way. Figure 15 illustrates typical access road cross-sections in the various terrain conditions.

TABLE 8 ACCESS ROAD CATEGORIES AND DISTURBANCE ASSUMPTIONS FOR FEIS ANALYSIS

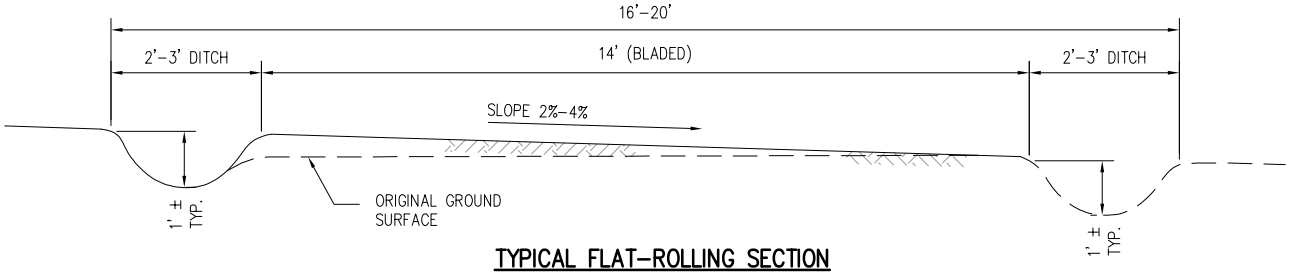
ACCESS ROAD CATEGORY	TERRAIN TYPES	ASSUMPTIONS FOR ESTIMATING DISTURBANCE
	Backbone Access Road Network Outside FEIS Corridors	
Category 1 – Existing Improved Roads	All terrain types	Geographic Information System (GIS) data provided. No ground disturbances would occur.
Category 2 (A) – Existing Roads Outside FEIS Corridor Requiring	All terrain types	GIS data provided. Access roads widths estimated 16 to 24 feet wide depending on terrain.

ACCESS ROAD CATEGORY	TERRAIN TYPES	ASSUMPTIONS FOR ESTIMATING DISTURBANCE
Improvements		
Access Roads Inside FEIS Corridors for Greenfield Alternatives		
Category 1 – Existing Improved Roads	All terrain types	GIS data provided. No ground disturbances would occur.
Category 2 (B) – Existing Roads Inside FEIS Corridor Requiring Improvements	All terrain types	For the FEIS analysis, a percentage of the length of Category 2B roads is considered new roads, under Road Categories 3-6.
Category 3 – New Access Roads in Flat Terrain	Flat – 0-8% slopes	Ratio of access road miles to one mile of transmission line – 1.2 miles Access Road Width – 16 feet
Category 4 – New Access Roads in Rolling Terrain	Rolling – 8-15% slopes	Ratio of access road miles to one mile of transmission line – 1.3 miles Access Road Width – 18 feet
Category 5 – New Access Roads in Steep Terrain	Steep – 15-25% slopes	Ratio of access road miles to one mile of transmission line – 1.8 miles Access Road Width – 22 feet
Category 6 – New Access Roads in Mountainous Terrain	Mountainous – greater than 25% slopes	Ratio of access road miles to one mile of transmission line – 2.7 miles Access Road Width – 24 feet
Access Roads Inside FEIS Corridors for Co-Located Alternatives		
Category 1 – Existing Improved Roads	All terrain types	GIS data provided. No ground disturbances would occur.
Category 2 (B) – Existing Roads Inside FEIS Corridor Requiring Improvements	All terrain types	For the FEIS analysis, a percentage of the length of Category 2B roads is considered new roads, under Road Categories 3-6.
Category 3 – New Access Roads in Flat Terrain	Flat – 0-8% slopes	Ratio of access road miles to one mile of transmission line – 0.8 miles Access Road Width – 16 feet
Category 4 – New Access Roads in Rolling Terrain	Rolling – 8-15% slopes	Ratio of access road miles to one mile of transmission line – 1.1 miles Access Road Width – 18 feet
Category 5 – New Access Roads in Steep Terrain	Steep – 15-25% slopes	Ratio of access road miles to one mile of transmission line – 1.6 miles Access Road Width – 22 feet
Category 6 – New Access Roads in Mountainous Terrain	Mountainous – greater than 25% slopes	Ratio of access road miles to one mile of transmission line – 2.4 miles Access Road Width – 24 feet

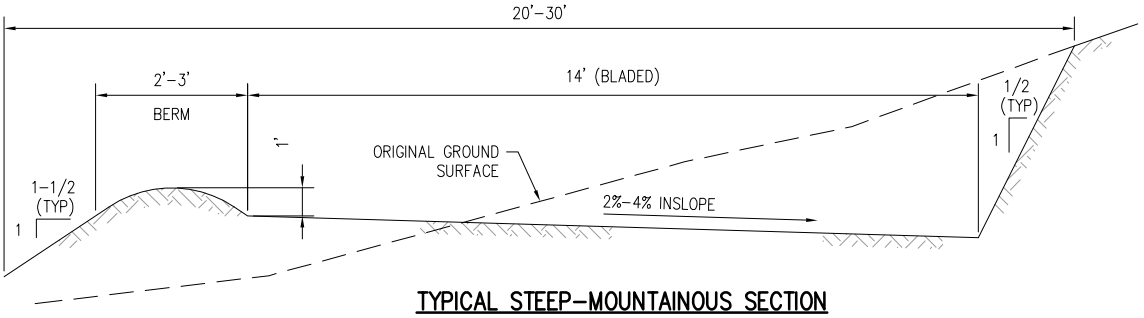
Construction of new access roads will begin with vegetation removal to the extent required for new road development. Vegetation management is described in Appendix R, ROW Preparation and Vegetation Management Plan. For bladed roads and where appropriate, topsoil will be removed and salvaged from the road construction area as required by the appropriate land management agency or private landowner. Topsoil will be stored adjacent to the road or in a nearby workspace. Based on terrain and grade of the road, new bladed access roads will be constructed with an inslope or outslope design with water dips, water bars, water breaks and wings in the berm as necessary to manage water

flow on the road and mitigate erosion. Figure 16 illustrates typical water bar cross-sections to be used to manage water flow on access roads in areas of steep terrain. Appropriate erosion control devices will be installed to prevent erosion or loss of the topsoil, including measures to prevent wind erosion and fugitive dust, and silt fencing to prevent sediment runoff. As needed, the structure site construction pads and access roads will be bladed/graded to allow for safe access and construction. The blading/grading may include cut and fill as needed to achieve a safe, workable surface.

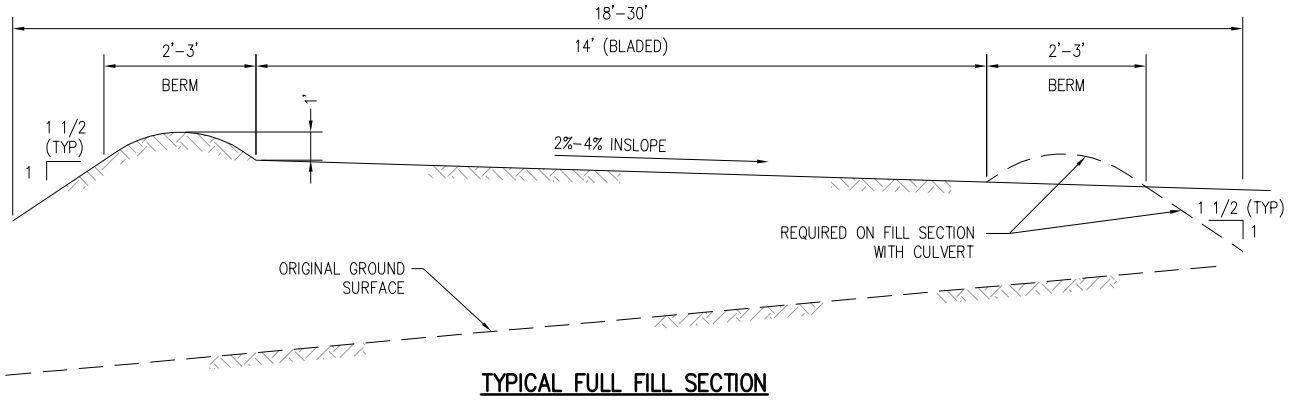
Access road construction may employ heavy equipment including bulldozers, front-end loaders, dump trucks, backhoes, excavators - both tracked and rubber-tired, and graders. Other specialized equipment including boom trucks to install culverts in some areas will be used where needed.



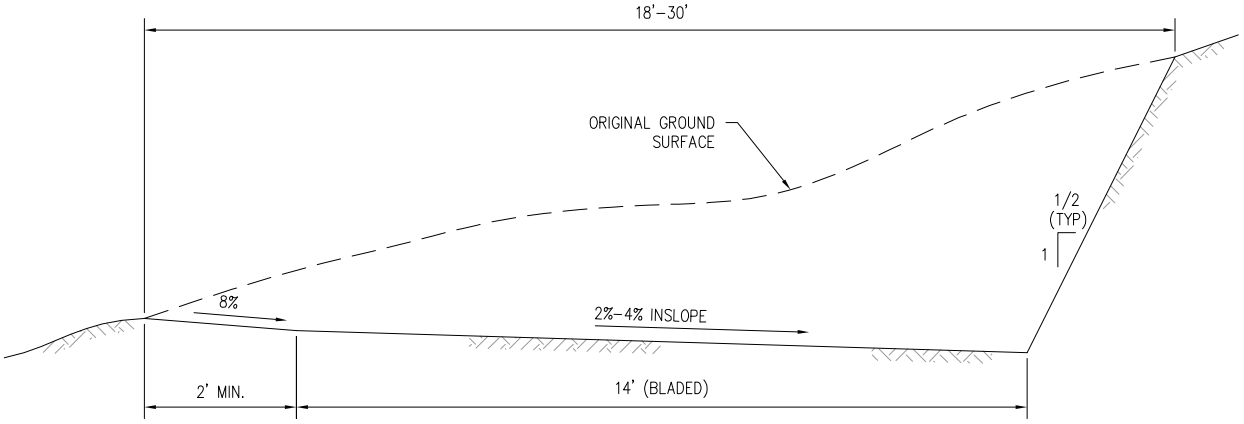
TYPICAL FLAT-ROLLING SECTION



TYPICAL STEEP-MOUNTAINOUS SECTION



TYPICAL FULL FILL SECTION



TYPICAL FULL CUT SECTION

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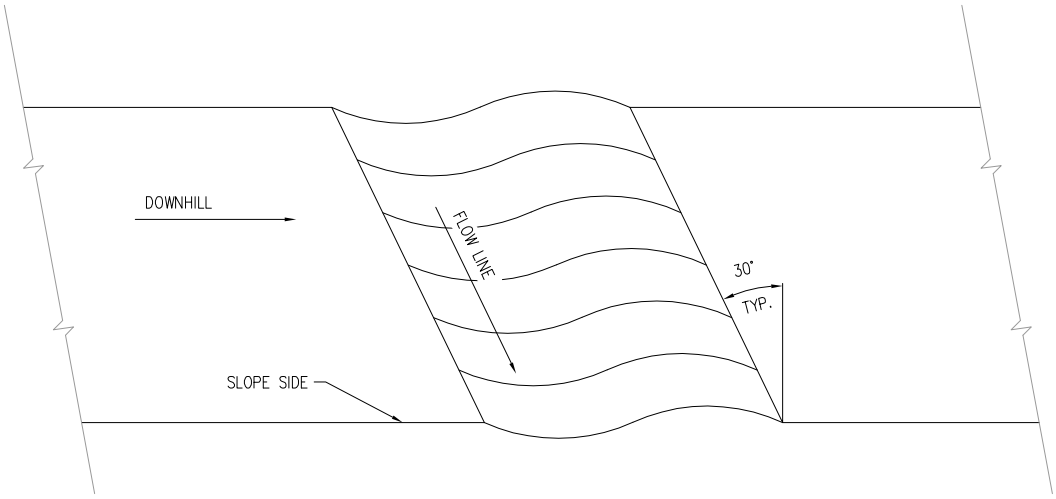
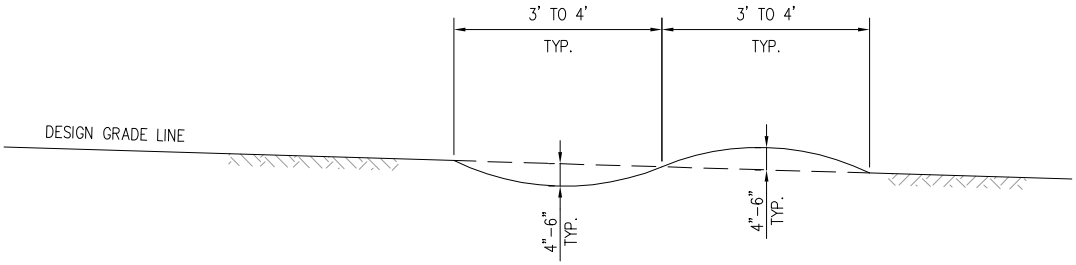
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 15

TYPICAL ACCESS ROAD CROSS-SECTIONS BY TERRAIN TYPE

WATER BARS





TYPICAL PROFILE

DISTANCE BETWEEN WATER BARS

ROAD GRADE PERCENT	SPACING FEET
2	250
5	135
10	80
15	60
20	45

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FIGURE 16
TYPICAL ROADS – WATER BARS

5.2.2 Clearing of Transmission ROW and Temporary Work Areas

Vegetation within the ROW will be cleared in accordance with the ROW Preparation and Vegetation Management Plan in Appendix R. Figure 17 provides a plan view of typical transmission ROW and temporary work areas.

Temporary work areas will be cleared of vegetation or flagged, as needed, prior to construction. Temporary work areas will include staging areas; material storage yards; fly yards; pulling, tensioning and spicing sites; work areas at each structure site; batch plant sites; and guard structures. Table 9 summarizes the temporary land disturbance that would be required for Project construction including the typical size and spacing required for the TWE Project facilities and activities.

TABLE 9 SUMMARY OF TEMPORARY LAND DISTURBANCE FOR WORK AREAS

TEMPORARY WORK AREA	DIMENSIONS/ SIZE	LOCATION AND NUMBER OF FREQUENCY NEEDED
TWE Project Transmission Line		
Staging Areas / Fly Yards	Average size: 7 acres	Approximately every 5 miles
Material Storage Yards	Average size: 20 acres	Approximately every 30 miles
Wire Pulling, Tensioning and Splicing Sites	ROW width x 500 feet for dead-end structure	Two sites at every dead-end structure
	ROW width x 500 feet for mid-span conductor and shield wire	Approximately every 9,000 feet
	100 x 500 feet for fiber optic cable set-up sites	Approximately every 18,000 feet
Structure Work Areas	ROW width x 200 feet per structure	All structure sites, average 4 per mile
Batch Plants	Average size: 5 acres	Approximately every 15 miles
TWE Project Northern and Southern Terminals		
Storage and Concrete Batch Plant	7.5 acres	On-site
Interconnection Line Structure Work Areas	200 feet x 200 feet (230 kV structures)* ROW width x 200 feet (500 kV structures)	All structure sites Approximately 6 per mile for 230 kV* Approximately 4 per mile for 500 kV
Interconnection Line Wire Pulling, Tensioning, Splicing Sites	ROW width x 500 feet	Mid-span conductor and shield wire sites – every 9,000 feet
	(230 kV ROW width – 100 feet)*	Fiber optic cable set-up sites – every 18,000 feet
	(500 kV ROW width – 250 feet)	Splicing sites typically at the same locations as the pulling/tensioning sites per common construction practices
TWE Project Northern and Southern Ground Electrode Systems		
Ground Electrode Site	65 acres	On-site
Overhead Electrode Line, Structure Work Areas	ROW width x 100 feet (34.5 kV ROW width – 50 feet)	All structure sites, average 18 per mile
Overhead Electrode Line, Pulling, Tensioning, and Splicing Sites	75 feet x 100 feet	Mid-span conductor sites – every 9,000 feet
	75 feet x 150 feet	All dead-end structure sites – two sites each
Material Storage Yards	10 acres	One at each ground electrode site (total of two)

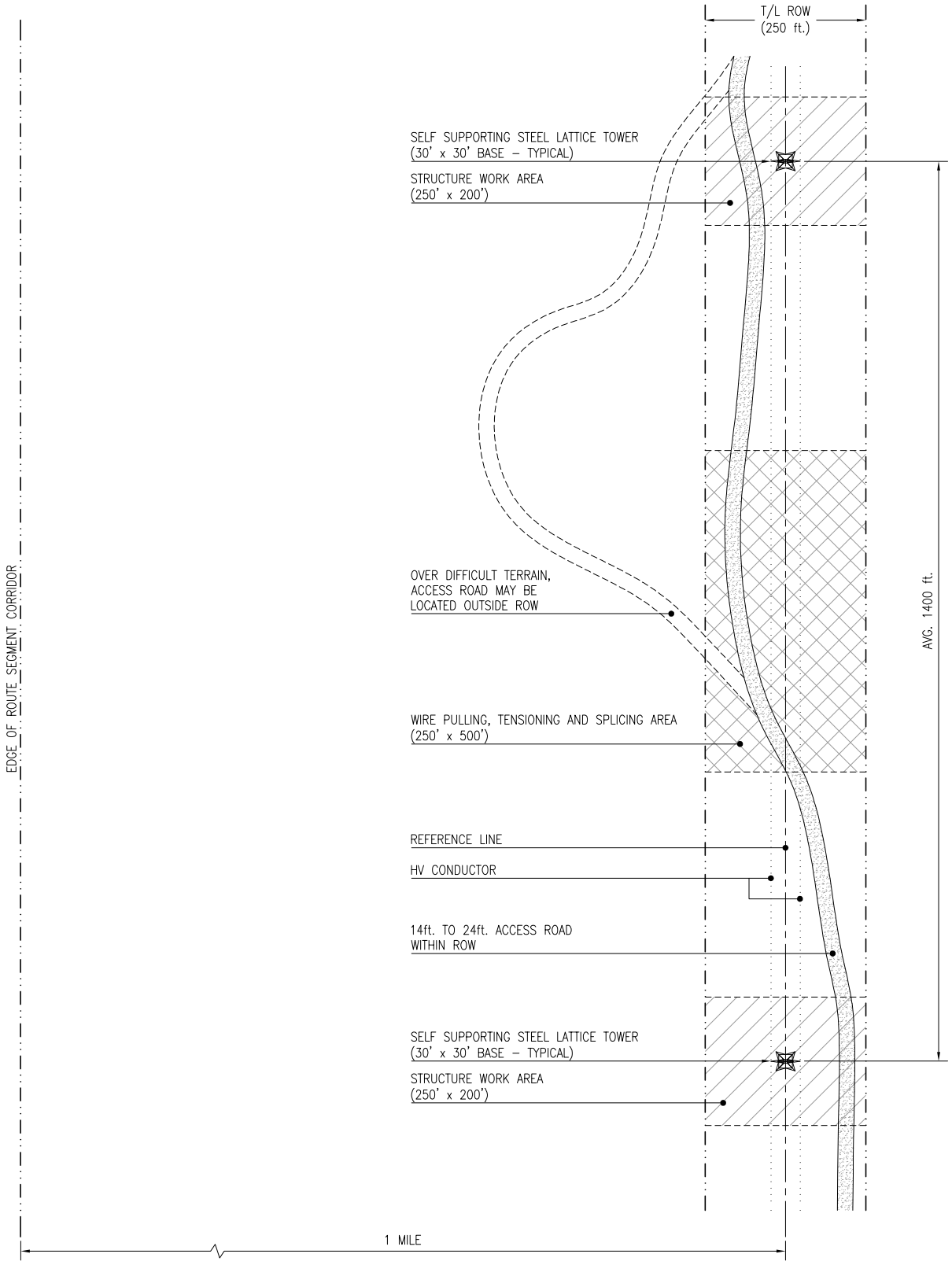
Notes: *Only applies to Northern Terminal

The following is a summary of the purpose and use of structure work areas; wire-pulling, tensioning and splicing sites; construction staging areas/fly yards; concrete batch plants; and equipment staging and refueling sites.

Structure Work Areas

Individual structure sites will be cleared to install the transmission line structures and facilitate access for future transmission line and structure maintenance. At each structure location (±600 kV DC and 500 kV), an area up to approximately 250 by 200 feet, will be needed for construction laydown, structure assembly, and erection at each structure site. This temporary disturbance will occur within the ROW. To the extent necessary, the work area will be cleared of vegetation and bladed to create a safe working area for placing equipment, vehicles, and materials. After line construction, all areas not needed for normal transmission line maintenance, including fire and personnel safety clearance areas, will be graded to blend as near as possible with the natural contours, then revegetated as required.

Additional equipment may be required if solid rock is encountered at a structure location. Rock-hauling, hammering, or blasting may be required to remove the rock. Excess rock that is too large in size or volume to be spread at the individual structure sites will be hauled away and disposed of at approved landfills or at a location specified by the appropriate agency or landowner. See *Excavating and Installing Foundations* below for additional information on blasting activities.



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 17

PLAN VIEW OF TYPICAL TRANSMISSION ROW
& CONSTRUCTION WORK AREAS

Wire Pulling, Tensioning, and Splicing Sites

Wire pulling, tensioning and splicing sites will be cleared and bladed as necessary to perform safe wire installation construction activities. During planning for wire installation activities wire pulling, tensioning, and splicing sites will be selected to minimize clearing and blading to the extent practical such that actual disturbance areas will not exceed those described in Table 8. After line construction, all areas disturbed for wire pulling, tensioning and splicing sites will be restored as described in Appendix Q, ROW Preparation and Vegetation Management Plan.

Construction Staging Areas/Fly Yards

The staging areas will be located in previously disturbed sites or in areas of minimal vegetative cover where possible. The staging areas will serve as field offices; reporting locations for workers; parking space for vehicles and equipment; and sites for material storage, fabrication assembly, concrete batch plants, and stations for equipment maintenance. Staging area dimensions and disturbance areas are summarized in Table 9. Additionally, fly yards for helicopter operations will be located approximately every five miles along the route where helicopter construction is planned, and will occupy approximately seven acres.

Depending upon location, use, type of material or equipment stored, adjacent land use or agency or landowner requirements, the Contractor may be required to provide necessary security arrangements at staging areas such as fencing and/or security guards. Staging area locations will be finalized following discussion with the land management agency or negotiations with landowners. In some areas, the staging area may need to be scraped by a bulldozer and a temporary layer of rock laid to provide an all-weather surface. Unless otherwise directed by the landowner, the rock will be removed from the staging area upon completion of construction and the area will be restored.

Concrete Batch Plant Sites

Concrete for use in the structure foundations will be dispensed from portable concrete batch plants located at approximately 15-mile intervals along the ROW, most located at staging areas adjacent to or near hard surface roadways. Initial site selection will be identified in the ROD POD with final sites identified in the NTP POD. Equipment typically required at a batch plant site includes generators, concrete trucks, front-end loaders, Bobcat loaders, dump trucks, transport trucks and trailers, water tanks, concrete storage tanks, scales, and job site trailers. Rubber-tired trucks and flatbed trailers will be used to assist in relocating the portable plant along the ROW. Commercial ready-mix concrete may be used when access to structure construction sites is economically feasible.

Equipment Staging and Refueling Sites

Staging of equipment will be located at staging areas, pulling and tensioning sites, or other temporary work areas previously described. These areas will be used to temporarily lay out equipment to be used for work on specific TWE Project activities at nearby locations.

During construction, the Contractor will implement standard refueling procedures for heavy equipment that is left on the ROW for long periods of time such as cranes, blades, dozers, drill rigs, etc. This equipment will be refueled in place. As a rule, no personal or light-duty vehicles will be allowed to refuel on the ROW. Procedures and precautions similar to those used for helicopter refueling (discussed below) will be utilized.

Staging areas and helicopter fly yards where helicopters are parked or refueled may be fenced with security guards stationed as needed.

5.2.3 Excavation and Installation of Foundations and Anchors

Foundations for guyed steel lattice towers will typically be small precast or cast-in-place concrete pedestals. The precast pedestals will be hauled to the tower site on a flatbed truck and set in a small excavation dug by a backhoe or digger. Although not anticipated, site-specific foundation design other than the concrete pedestals could be warranted depending on subsurface conditions. The single shaft tubular steel poles and self supporting steel lattice towers will typically be supported by cast-in-place drilled concrete pier foundations. For these structure types, vertical excavations for foundations will be made with power drilling equipment. Where soils permit, truck-or track-mounted augers of various sizes, depending on the diameter and depth requirements of the hole to be drilled, will be used.

In rocky areas, the foundation holes may be excavated by drilling or blasting methods, or installing special rock anchor or micro-pile type foundations. The rock anchoring or micro-pile system will be used in areas where site access is limited, or adjacent structures could be damaged as a result of blasting or rock hauling activities. If hard rock is encountered within the planned drilling depth of tower foundations, blasting may be required to loosen or fracture rock. Potential areas requiring blasting will be identified based on geological setting of the proposed alignment. A Blasting Plan (Appendix C) is being prepared as part of the POD. It details the general concepts proposed to achieve the desired excavations, proposed methods for blasting warning, use of non-electrical blasting systems, provisions for controlling fly rock, vibrations, and air blast damage. Blasting is described in detail in Section 5.7.1.

In environmentally sensitive areas with very soft soils, a HydroVac, which uses water pressure and a vacuum, may be used to excavate material into a storage tank. Alternatively, a temporary casing may be used during drilling to hold the excavation open, and then the casing is withdrawn as the concrete is placed in the hole. In areas where it is not possible to operate large drilling equipment due to access or environmental constraints, hand-digging may be required.

In areas where single shaft tubular steel pole structures are used, increased volumes of excavated subsoil spoils, based on foundation size and depth are anticipated. These excess subsoil spoils will be disposed of in locations and methods as previously agreed upon by the Applicant and the appropriate land management agency or private landowner.

Methods and locations of disposal of material excavated from any type of foundation will consider hauling offsite to an approved disposal area, spreading within the general disturbance area to maintain grades and runoff, and to facilitate restoration (in these instances, topsoil will be salvaged and set aside to be placed over the subsoil material during restoration) and using spoil material as backfill for fill areas or to maintain graded access roads. Each of these disposal options will be mitigated on a case-by-case basis as agreed upon by the Applicant and the appropriate land management agency or private landowner.

Foundation or anchor holes left open or unguarded will be covered to protect the public and wildlife. If practical, fencing may be used. All safeguards associated with using explosives (e.g., blasting mats) will be employed. Blasting activities will be coordinated with the appropriate agencies, particularly for purposes of safety and protection of sensitive areas and biological resources (see Appendix C Blasting Plan). In extremely sandy areas, water or an appropriate land management agencies' approved gelling agent may be used to stabilize the soil before and during excavation.

Reinforced-steel anchor bolt cages will be installed after excavation and prior to structure installation. These cages are designed to increase the structural integrity of the foundations, will be assembled at

the nearest laydown yard or staging area, and delivered to the tower site via flatbed truck. These cages will be inserted in the holes prior to pouring concrete. The excavated holes containing the reinforcing anchor bolt cages will be filled with concrete.

Typically, and because of the remote location of much of the transmission line route, concrete will be provided from portable batch plant areas as described above. Concrete will be delivered directly to the site in concrete trucks with a capacity of up to ten cubic yards. In the more developed areas along the route, the Contractor may use local concrete providers to deliver concrete to the site when available and economically feasible. Concrete trucks will be washed in designated areas within the ROW more than 100 feet from streams and wetlands. The hardened waste concrete will be removed from the site and properly recycled or disposed of.

Guyed lattice structures require the installation of anchors and guy wires to support the structure. Depending upon the soil type and engineering strength requirements, anchors will be either excavated plate anchors, drilled and epoxy, or grouted anchors.

Drilled anchors will require a small truck or track mounted drilling equipment that will drill a hole four to eight inches in diameter, 20 to 40 feet or more in depth. The anchor rod is inserted into the open bore and secured to the soil or rock either with epoxy or grout.

Plate anchors are installed in a three to four foot diameter excavation, 10 to 20 feet in depth, drilled by a small truck or track mounted drilling rig. The anchor rod is attached to the plate anchor, placed in the hole and the excavation is backfilled and compacted.

5.2.4 Erection of Transmission Structures

Bundles of steel members and associated hardware (insulators, hardware, and stringing sheaves) will be transported to each structure site by truck. Wood blocking will be hauled to each location and laid out; the tower steel bundles will be opened and laid out for assembly by sections and assembled into subsections of convenient size and weight. Typically, the leg extensions for the towers will be assembled and erected by separate crews with smaller cranes to make ready for setting of the main tower assembly. The assembled subsections will then be hoisted into place by means of a large crane and fastened together to form a complete tower. A follow-up crew will then tighten all the bolts in the required joints. Refer to Figure 13 for a general illustration of this procedure. The use of helicopters for structure erection is described in Section 5.7.2 Helicopter Construction.

5.2.5 Stringing of Conductors, Shield Wire, and Fiber Optic Ground Wire

Insulators, hardware, and stringing sheaves will be delivered to each tower site. The towers will be rigged with insulator strings and stringing sheaves at each shield (ground) wire and conductor position.

Interruption of road traffic on all types of roads (county, state, federal, interstate) is not anticipated during conductor stringing and tensioning activities unless required under the terms and conditions of a specific road or highway crossing permit. As described below, pilot lines will be pulled from tower to tower by either a helicopter (most commonly) or land operated equipment. The use of a helicopter to pull the pilot lines is commonly used so that impacts to road traffic are minimized or avoided. For safety and efficiency reasons, wire stringing and tensioning activities are typically performed during daylight hours and are scheduled to coincide to the extent practical with periods of least road traffic in order to minimize traffic disruptions.

Railroad crossing operations and procedures are controlled by and permitted through the railroad company operating the affected rail line (see the Union Pacific Railroad website for Overhead Wire Crossings as an example). Terms and conditions to be followed are specified in the crossing permit. 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 as discussed below. Stringing and tensioning activities will be performed in coordination with the appropriate railroad authorities. For safety and efficiency, stringing and tensioning activities are performed during daylight periods and scheduled to coincide with times of least railroad traffic. The railroad will typically provide a switchman who is present at all times when work is being performed near or over any railroad line.

For protection of the public during stringing activities, temporary guard structures will be erected at road crossing locations where necessary. Guard structures will typically consist of H-frame wood poles placed on either side of the road to prevent ground wires, conductors, or equipment from falling on underlying facilities and disrupting road traffic. Typically, guard structures are installed just outside of the road ROW. Although the preference is for access to each of these guard structures to be located outside the road ROW, it may be necessary for access to be within the road ROW depending on topography and access restrictions imposed by the regulatory agency (i.e., USDOT, county road and bridge department). Access use within the road ROW will be performed in compliance with the stipulations of the crossing permit and regulatory agency requirements.

Site specific road crossing locations with excessive widths (generally greater than 200 to 300 feet) such as may occur on interstate highways would require installation of temporary guard structures in medians between opposite traffic flow lanes. Although the Applicant does not currently anticipate needing guard structures in medians, as final engineering design progresses, locations requiring center median guard structures may be identified. The erection and dismantling of these temporary guard structures may require short-term traffic diversions.

All traffic impacts resulting from wire stringing including short-term traffic diversions, traffic congestion and brief road closures (if needed) will comply with the Traffic and Transportation Management Plan (Appendix U). Short-term traffic diversions, which may last from a few hours to a day, are most commonly a short duration closure of the shoulder of the road or in more congested locations might consist of the closure of one lane of traffic. Complete closure of one direction of traffic is not anticipated. Temporary traffic diversion signs, signals, markers, barriers and traffic control personnel, if required by the State Department of Transportation (DOT), will be employed. These activities would be coordinated with the appropriate State DOTs. Traffic disruptions will be kept to a minimum and the Applicant will comply with crossing permit requirements which typically limit durations of traffic interruptions.

In urban locations or for extremely high volume roadways (such as interstate highways), the State DOTs may require the installation of protective steel netting above the roadway for the duration of wire stringing and tensioning operations (generally ranging from a few days to two to three weeks). The installation of protective steel netting requires a brief closure of the roadway while the netting is pulled across the roadway and hoisted onto the temporary support structures. This process is repeated when the netting is removed. Because of the heavy traffic volume and the impact of stopping traffic, netting is typically installed during the lowest traffic period (normally 3 a.m. to 5 a.m. on a Sunday morning) per the requirements of the State DOT. Although not anticipated, any road stoppage will employ all appropriate State DOT traffic safety requirements (signage, flagmen, lighting, signals, temporary barriers, law enforcement, etc.).

Equipment for erecting guard structures will include augers, backhoes, line trucks, boom trucks, pole trailers, and cranes. Guard structures may not be required for small roads. In such cases, other safety measures such as barriers, flagmen, or other traffic controls will be used. Following stringing and tensioning of all ground wires and conductors, the guard structures will be removed and the area restored.

Pilot lines will be pulled (strung) from tower to tower by either a helicopter or land operated equipment, and threaded through the stringing sheaves at each tower. Following pilot lines, a stronger, larger diameter line will be attached to conductors to pull them onto towers. This process will be repeated until the shield wire, optical ground wire, and conductor is pulled through all sheaves.

Shield wires, fiber optic cable, and conductors will be strung using powered pulling equipment at one end and powered braking or tensioning equipment at the other end of a conductor segment. Site dimensions for pulling and tensioning equipment are provided in Table 9. These sites may differ in size and dimensions, however, depending on the structure's purpose (e.g., mid-span or dead-end), site-specific topography, and whether anchoring of the shield wire or conductor will be located at these sites. The tensioner, in concert with the puller, will maintain tension on the ground wires or conductor while they are fastened to the towers. Once each type of wire has been pulled in, the tension and sag will be adjusted, stringing sheaves will be removed, and the conductors will be permanently attached to the insulators.

Caution will be exercised during construction to avoid scratching or nicking the conductor surface, which may provide points for corona to occur. Refer to Figure 13 for a general illustration of this procedure.

At tangent and small-angle towers, the conductors will be attached to the insulators using clamps while at the larger angle dead-end structures the conductors are cut and attached to the insulator assemblies by "dead-ending" the conductors, either with a compression fitting or an implosive type fitting. Both are industry-recognized methods. When utilizing the implosive type fitting, pertinent land management agencies, private landowners, and public safety organizations will be notified before proceeding with this method.

Part of standard construction practices prior to conductor installation will involve measuring the resistance of the ground to electrical current near the towers. If the measurements indicate a high resistance, counterpoise will be installed, which will consist of trenching in-ground wire to a depth of 12 inches in non-cultivated land and 18 inches in cultivated land, with a ground rod driven at the end. The counterpoise will be contained within the limits of the ROW and may be altered or doubled back and forth to meet the requirements of the TWE Project. Typical equipment used for installing ground rods includes line trucks, backhoes, and trenchers.

5.3 Terminal and Substation Construction

Terminal construction activities will occur at the Northern and Southern Terminals. Section 5.8.3 summarizes the types of construction equipment to be used at each terminal, substation or series compensation station.[1]

[1] Terminal construction for the proposed Project includes the adjacent substations. Separate substations and/or series compensation stations are required for Design Options 2 and 3. Descriptions of the construction for the

Construction of the AC/DC converter stations, substations or series compensation stations will initially consist of survey work, geotechnical sample drillings approximately 20 to 50 feet deep, and soil resistivity measurements that will be used in the final design phases of the station. Once the final design of the station has been completed, a Contractor will mobilize to perform site development work, including grubbing and then reshaping the general grade to form a relatively (one percent slope) flat working surface. This effort also will include the construction of permanent all-weather access roads. An eight-foot-tall chain link fence will be erected around the perimeter of the terminal, substation or series compensation station to prevent unauthorized personnel from accessing the construction and staging areas. The perimeter fence will be a permanent feature to protect the public from accessing the facility. The excavated and fill areas will be compacted to the required densities to allow structural foundation installations. Oil containment structures required to prevent oil from transformers, reactors, circuit breakers, etc., from getting into the ground or water bodies in the event of rupture or leak, will be installed.

Following the foundation installation, underground electrical raceways and copper ground grid installation will take place, followed by steel structure erection and area lighting. The steel structure erection will overlap with 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 converter valve hall and ancillary buildings will be erected. The installation of the high-voltage transformers will 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. While the above mentioned activities are taking place, the enclosures that contain the control and protection equipment for the terminal, substation and series compensation station will be constructed, equipped, and wired. A final crushed rock surface will be placed on the subgrade to make for a stable driving and access platform for the maintenance of the equipment. After the equipment has been installed, testing of the various systems will take place, followed by electrical energization of the facility. The energization of the facility generally is timed to take place with the completion of the transmission line work and other required facilities.

Soil Borings

Typically, soil borings will be made on 600-foot grid spacing within the terminal, substation or series compensation station, particularly at the approximate location of large structures and equipment such as substation dead-ends and transformers, to determine the engineering properties of the soil for foundation design. Borings will be made with truck- or track-mounted equipment. The borings will be approximately four inches in diameter, range from 20 to 50 feet deep, and be backfilled with the excavated material upon completion of soil sampling.

Clearing and Grading

The Contractor will mobilize to perform site development work including grubbing, grading and construction of an all-weather access road (gravel). Clearing of all vegetation will be required for the entire terminal, substation or series compensation station area, including a distance of approximately eight to ten feet outside the fence.

Once the vegetation is cleared, the entire site will be graded essentially flat, with enough slope to provide for runoff of precipitation. The site will be graded to use existing drainage patterns to the extent possible. Depending upon the size of the site a more complex drainage design may be required

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substations and series compensation station for Design Options 2 and 3 are included within this section for convenience and completeness.

to handle larger volumes of runoff. Drainage design for large sites may require drainage zones, retention basins, and drainage structures such as ditches or culverts. Discharge of stormwater during construction will require State specific Stormwater Pollution Prevention Plans. A framework Stormwater Pollution Prevention Plan is provided in Appendix T. After grading, the entire site will be treated with a soil sterilizer to prevent vegetation growth to minimize future maintenance. Clearing and grading material will be disposed of in compliance with local ordinances. Material from off-site will be obtained at existing borrow or commercial sites and will be trucked to the site using existing roads and the site access road.

Once installation of foundations, underground electrical raceways and copper ground grid are completed, a four to six inch layer of crushed rock will be applied to the finished surface of the station to provide a solid all-weather working surface and to protect personnel from high currents and voltages during electrical fault conditions.

Storage and Staging Yards

Construction material storage yards may be located outside the terminal, substation or series compensation station-fenced area near the facility being constructed. These storage yards may be part of the terminal, substation series compensation station property or leased by the Contractor. After construction is completed, all debris and unused materials will be removed and the staging/storage yards returned to pre-construction conditions by the Contractor.

Grounding

A grounding system will be required in each terminal, substation and series compensation station for detection of faults and for personnel safety. The grounding system typically consists of buried copper conductor arranged in a grid and driven ground rods, typically eight to ten feet long. The ground rods and any equipment and structures are connected to the grounding conductor. The amount of conductor and length and number of ground rods required will be calculated based on fault current and soil characteristics.

Fencing and Lighting

Security fencing will be installed around the entire perimeter of each terminal, substation and series compensation station to protect sensitive equipment and prevent accidental contact with energized conductors by third parties. This seven-foot-high fence would be constructed of chain link with steel posts. One foot of barbed wire or similar material will be installed on top of the chain link yielding a total fence height of eight feet. Locked gates will be installed at appropriate locations for authorized vehicle and personnel access.

Safety and security lighting at the terminals, substations and series compensation stations will be provided inside the fence for safety and security, and for uncommon emergency night repair work. Dusk to dawn safety and security lighting will be used at the terminals and 500 kV AC substations.

Foundation Installation

Foundations for supporting structures and large buildings are of two types: spread footings or drilled piers. Spread footings are placed by excavating the foundation area, placing forms and reinforced-steel and anchor bolts, and pouring concrete into the forms. After the foundation has been poured, the forms would be removed, and the surface of the foundation finished. Drilled pier foundations are placed in a hole generally made by a track or truck-mounted auger. Reinforced-steel and anchor bolts are placed into the hole using a track or truck-mounted crane. The portion of the foundation above ground would be formed. The portion below ground uses the undisturbed earth of the augured hole as

the form. After the foundation has been poured, the forms would be removed, the excavation would be backfilled, and the surface of the foundation finished.

Equipment foundations for circuit breakers, transformers, and small prefabricated buildings will be slab-on-grade type. These foundations are placed by excavating the foundation area; placing forms, reinforced steel, and anchor bolts (if required); and placing concrete into the forms. After the foundations have been poured, the forms are removed, and the surface of the foundation finished. Where necessary, provisions will be made in the design of the foundations to mitigate potential problems due to frost. Reinforced steel and anchor bolts will be transported to each site by truck, either as a prefabricated cage or loose pieces, which will then be fabricated into cages on the site. Concrete will be hauled to the site in concrete trucks. Excavated material will be spread at the site or disposed of in accordance with agency requirements or local ordinances. Structures and equipment will be attached to the foundations by means of threaded anchor bolts embedded in the concrete. Some equipment, such as transformers and reactors, may not require anchor bolts.

Oil Containment

Some types of electrical equipment, such as transformers, and some types of reactors and circuit breakers, are filled with an insulating liquid. Containment structures are required to prevent equipment insulating liquids from getting into the ground or waterbodies in the event of a rupture or leak. These structures take many forms depending on site requirements, environmental conditions, and regulatory restrictions. The simplest type of containment is a pit, of a calculated capacity, under the equipment that has an impervious liner. The pit is filled with rock to grade level. In case of a leak or rupture, the liquid captured in the containment pit is pumped into tanks or barrels and transported to a disposal facility. If required, more elaborate containment systems can be installed. This may take the form of an on-site or off-site storage tank and/or insulating liquid-water separator equipment depending on site requirements.

Structure and Equipment Installation

Supporting steel structures are erected on concrete foundations. These are set with a track or truck-mounted crane and attached to the foundation anchor bolts by means of a steel base plate. These structures will be used to support the energized conductors and certain types of equipment. This equipment will be lifted onto the structure by means of a truck-mounted crane and bolted to the structures; electrical connections are then made. Some equipment, such as transformers, reactors, and circuit breakers, will be mounted directly to the foundations without supporting structures. These will be set in place by means of a truck-mounted crane. Some of this equipment requires assembly and testing on the pad. Electrical connections to the equipment will then be made.

Equipment Housing, Control, Storage and Ancillary Building Construction

The Project will require several buildings at each terminal, substation or series compensation site. Depending upon size and function, these buildings will be either prefabricated or constructed on-site as concrete block or metal clad steel frame buildings.

The following provides a brief description and approximate dimension of the building types generally required for the terminals:

> The **HVDC Converter Valve Hall** is a large building that contains the high-voltage electronics involved in the conversion process (referred to as valves), the valve cooling circulation system (pipes required to circulate the cooling medium), clean air exchange, and other supporting environmental conditions required for operation of the converter system.

The valves are typically suspended from the ceiling of the building which requires large clearance distances to the ground and surrounding structures due to the high voltages that are generated within the building during the conversion process. The building will be approximately 60 to 80 feet in height and the footprint will be approximately 200 by 80 feet. There will be two buildings of this size; one housing the valve equipment for the positive DC pole and the other housing the equipment for the negative DC pole.

An **HVDC Auxiliary Support Building** is typically placed between the two valve halls or very near the valve halls. This building contains the pumps and heat exchange system for cooling of the valves. The building is typically 100 feet wide, 100 feet long and approximately 20 feet high.

A **Main Operations Building** housing operations, general office and support functions is approximately 150 by 150 feet square and is typically a two-story building with a complete basement. The HVDC control room and supporting control systems are housed in a main operations building. The telecommunications equipment, the HVDC controls equipment, and the operational control room is typically located in separated secure spaces to assure safety and to restrict access to all levels of automation and telecommunication. Operations, administrative staff, and maintenance dispatch supporting facilities are also located within this building. Control spaces will be equipped with full ranges of uninterrupted power supply power protection, fire safety operations, and dispatcher coordination centers. This facility will also include the SCADA control and monitoring systems for the Project's entire AC substation, and transmission systems as necessary up to the points of interconnection with the regional grid.

The **Security Control Office Building** will be an approximately 30 by 30 foot single story building with a full basement, to facilitate life safety and other equipment including domicile facilities for security personnel on extended shift work.

The **Diesel Generator Building** will be an approximately 100 by 30 foot single story building. This building contains diesel generators and support equipment necessary to operate the facility on loss of the primary power source.

The **DC Switchyard Building** is typically a single story building of approximately 30 feet by 60 feet. One or more control buildings may be required at each terminal to house control devices, battery banks for primary control power, and remote monitoring equipment. The size and construction of the building will depend on DC switchyard requirements. Typically, the control building will be constructed of concrete block, pre-engineered metal sheathed, or composite surfaced materials. Once the control house is erected, protection and control equipment will be mounted and wired inside.

A **Hazardous Chemical and Dry Storage Building** will be developed to place the various chemical bulk storage and other items outside and apart from the other buildings in the terminal complex. This building will be approximately 30 feet by 30 feet. This building will be supplied with the code required containment, life, and fire safety systems.

A **Dry Indoor Storage Building** will be developed based on the requirements of the HVDC Contractor and is estimated to be approximately 100 feet by 150 feet, single story, high bay building.

The following provides a brief description and approximate dimension of the buildings types generally required for the terminals, substations and series compensation stations:

> The **AC Switchyard Control House** is typically a single story structure of approximately 30 feet by 60 feet. One or more control buildings may be required at each switchyard, substation or series compensation station to house protective relays, control devices, battery banks for primary control power, and remote monitoring equipment. The size and construction of the building will depend on individual substation requirements. Typically, the control building will be constructed of concrete block, pre-engineered metal sheathed, or composite surfaced materials. Once the control house is erected, protection and control equipment will be mounted and wired inside.

Conductor Installation

The two main types of high-voltage conductors used in terminals and substations are tubular aluminum for rigid bus sections and/or stranded aluminum conductor for strain bus and connections to equipment. Rigid bus will be a minimum of four inches in diameter and will be supported on porcelain or polymer insulators on steel supports. The bus sections will be welded together and attached to special fittings for connection to equipment. Stranded aluminum conductors will be used as flexible connectors between the rigid bus and the station equipment.

Conduit and Control Cable Installation

Most terminal and substation equipment requires low-voltage connections to protect relaying and control circuits. These circuits allow metering, protective functions, and control (both remote and local) of the power system. Connections will be made from the control building to the equipment through multi-conductor control cables installed in conduits and/or a pre-cast concrete cable trench system.

5.4 Ground Electrode Construction

Construction of the two ground electrode facilities will be initiated with a survey and staking to layout the location of the access road, deep earth electrode wells, control building and low voltage underground electrical, control and monitoring cables connecting the wells to the control building. The Contractor will mobilize to perform site development work including grubbing and grading and construction of an all-weather access road (gravel). Grubbing, grading, and contouring of the entire site is not required. Removal of vegetation will be required for the access road, control building site, well sites, alignments of the underground electrical, control and monitoring cables and on-site material storage yard/staging area.

Once the vegetation is cleared, the control building site will be graded essentially flat, with enough slope to provide for runoff of precipitation. After grading, the control building site will be treated with a soil sterilizer to prevent vegetation growth to minimize future maintenance. Next, a thin layer of gravel or crushed rock will be applied to the finished surface of the control building site. With the exception of the permanent and temporary access roads, no additional grading will be required. Clearing and grading material will be disposed of in compliance with local ordinances. Material from off-site will be obtained at existing borrow or commercial sites, and will be trucked to the ground electrode site using existing roads and the ground electrode site access road.

Security fencing will be installed around the perimeter of the control building site. This seven-foot-high fence would be constructed of chain link with steel posts. One foot of barbed wire or similar

material will be installed on top of the chain link yielding a total fence height of eight feet. A locked gate will be installed for authorized vehicle and personnel access.

Foundations for the prefabricated building will be slab-on-grade type. These foundations are placed by excavating the foundation area; placing forms, reinforced steel, and anchor bolts; and placing concrete into the forms. After the foundations have been poured, the forms are removed, and the surface of the foundation finished. Where necessary, provisions will be made in the design of the foundations to mitigate potential problems due to frost.

Reinforced steel and anchor bolts will be transported to each site by truck which will then be fabricated into cages on the site. Concrete will be hauled to the site in concrete trucks. Excavated material will be spread at the site or disposed of in accordance with agency requirements or local ordinances. The pre-fabricated building will be transported to the site by truck and attached to the foundations by means of threaded anchor bolts embedded in the concrete.

Each ground electrode site will require drilling approximately 60 deep earth wells. Each electrode well will be a 12 to 18 inch diameter bore drilled to a depth of 200 to 700 feet (depth based upon engineering and design). The well drilling will require small amounts of water which will be procured from commercial or municipal sources. Ground water will not be removed although small amounts of water, mud and spoil will be brought to the surface as part of the drilling process. All excess water, mud, drilling fluids, and spoils will be contained adjacent to the drill rig and when completed will be disposed of per landowner and agency requirements.

Once drilling is completed, a wire will be grouted into the well, the well capped, and a small area excavated around the well head for the installation of the utility access vault. A precast concrete utility access vault is installed. This utility access vault provides access to the well in addition to preventing public access to the well connections or electrode components.

Several underground cables are installed in trenches connecting each well to the control building. These cables provide a low voltage electrical connection from the control building to each well, and perform control and monitoring functions. Cables will be direct buried with the trench backfilled and compacted with spoil. Once backfilling is complete, the trenched area will be contoured back to match existing slopes and grades.

A communication system used for monitoring and control of the ground electrode facility will be installed. This communication link will require installation of either a buried or overhead fiber optic cable, and equipment or fixed radio communication equipment and antenna.

Connection to a local electric distribution circuit will be required to provide power to the site. Additionally, an emergency generator with a liquid propane gas fuel tank will be installed adjacent to the control building inside the fenced area.

5.5 Communications System Construction

The fiber optic network will require regeneration sites at periodic distances along the transmission line, as determined in the detailed engineering studies. In general, these regeneration sites are planned to be within the transmission line ROW. The communications system facilities will be constructed concurrently with the transmission line.

Construction will be initiated with a survey and staking to layout the location, and extent of the regeneration site. The Contractor will mobilize to perform site development work including grubbing, grading, and construction of an all-weather access road (gravel).

Clearing of all vegetation will be required for the entire regeneration site, including a distance of approximately eight to ten feet outside the fence. Once the vegetation is cleared, the entire regeneration site will be graded essentially flat, with enough slope to provide for runoff of precipitation. After grading, the entire site will be treated with a soil sterilizer to prevent vegetation growth to minimize future maintenance. Next, a thin layer of gravel or crushed rock will be applied to the finished surface of the regeneration site. Clearing and grading material will be disposed of in compliance with local ordinances. Material from off-site will be obtained at existing borrow or commercial sites, and will be trucked to the regeneration site using existing roads and the regeneration site access road.

Security fencing will be installed around the entire perimeter of each regeneration station. This seven-foot-high fence would be constructed of chain link with steel posts. One foot of barbed wire or similar material will be installed on top of the chain link yielding a total fence height of eight feet. A locked gate will be installed for authorized vehicle and personnel access.

Foundations for the prefabricated building(s) will be slab-on-grade type. These foundations are placed by excavating the foundation area; placing forms, reinforced steel, and anchor bolts; and placing concrete into the forms. After the foundations have been poured, the forms are removed, and the surface of the foundation finished. Where necessary, provision will be made in the design of the foundations to mitigate potential problems due to frost.

Reinforced steel and anchor bolts will be transported to each site by truck which will then be fabricated into cages on the site. Concrete will be hauled to the site in concrete trucks. Excavated material will be spread at the site or disposed of in accordance with agency requirements or local ordinances. Pre-fabricated building(s) will be transported to the site by truck and attached to the foundations by means of threaded anchor bolts embedded in the concrete.

The fiber optic cable will be connected from the splice box located near the bottom of the nearest transmission structure to the control building at the regeneration site via two diverse paths, either overhead or underground. The overhead path may require one, two or three short distribution type poles all located on the transmission ROW. An underground path will require trenching and burial of an underground fiber optic cable. All trenching is to occur on the transmission ROW.

Connection to a local electric distribution circuit will be required to provide power to the site. Additionally, an emergency generator with a liquid propane gas fuel tank will be installed at the site inside the fenced area.

A short tower (generally less than 30 feet) with a UHF/VHF radio antenna will be installed to provide communication support for transmission line patrol and maintenance operations and allow emergency operations independent of commercial common carrier (i.e., cellular telephone).

5.6 Post-Construction Clean-Up and Restoration

Terminal, ground electrode, series compensation station and transmission line construction will generate a variety of solid wastes including concrete, hardware, and wood debris. The solid wastes generated during construction will be recycled or hauled away for disposal. Excavation along the

ROW and at terminals and substations will generate excavated subsoil spoil that could potentially be used as fill; however, some of the excavated material will be removed for disposal.

The majority of waste associated with terminal and substation construction results from spoils created during site grading. Very little of the soil excavated during foundation installation is waste product. Above-grade waste will be packing material such as crates, pallets, and paper wrapping to protect equipment during shipping. It is assumed a 12-yard dumpster will be filled once a week with waste material for the duration of each terminal or substation project.

Clean-up and restoration will consist of:

- Removing packing crate reels, shipping material and debris, and disposing of them at approved landfill sites;
- Backfilling holes and ruts in access roads, installing water bars, and doing final grading;
- Dressing work sites and structure sites to remove ruts;
- Mitigating soil compaction and leveling, disking, and preparing areas for seeding, as required;
- Maintaining permanent access roads as needed for future maintenance work;
- Leaving access roads in place, but not regularly maintaining them. Access roads will be graded, have water bars installed, and reseeded to encourage vegetation cover according to appropriate land management agency or private landowner requirements;
- Repairing fences and gates to their original condition or better;
- Grounding fences;
- Seeding and revegetating, as specified in the Appendix Q Reclamation Plan and in accordance with appropriate land management agency or private landowner requirements; and
- Contacting property owners and processing claims for settlement.

5.7 Special Construction Practices

5.7.1 Blasting

As described earlier in this section, foundations for tubular steel poles and self supporting steel lattice towers will normally be installed using drilled shafts or piers. Foundations for guyed steel lattice towers will typically be small precast or cast-in-place concrete pedestals. If hard rock is encountered within the planned drilling depth, blasting may be required to loosen or fracture the rock to reach the required depth to install the tower foundations. Areas where blasting will likely occur will be identified during final design based on the geologic conditions of the selected Alternative alignment as determined by the geotechnical investigation. The Contractor will be required to prepare a Blasting Plan for the Project, subject to the approval of the Applicant. The Blasting Plan will detail the Contractor's proposals for compliance with the Applicant's blasting specifications and Blasting Plan framework (Appendix C), and will detail the general concepts proposed to achieve the desired excavations. In addition, the Blasting Plan will address proposed methods for controlling fly rock, for

blasting warnings, and for use of non-electrical blasting systems. The Contractor will be required to provide data to support the adequacy of the proposed efforts regarding the safety of structures and slopes and to ensure that an adequate foundation is obtained. When utilized, blasting will take place between sunrise and sunset.

The Blasting Plan will contain shot plans which will detail the drilling and blasting procedures; the number, location, diameter, and inclination of drill holes; the amount, type, and distribution of explosive per hole and delay; and pounds of explosive per square foot for pre-splitting and smooth blasting. The Contractor will be required to maintain explosives logs.

Blasting near buildings, structures, and other facilities susceptible to vibration or air blast damage will be carefully planned by the Contractor and the Applicant, and controlled to eliminate the possibility of damage to such facilities and structures. The Blasting Plan will include provisions for control to eliminate vibration, fly rock, and air blast damage.

Blasting will be very brief in duration (milliseconds), and the noise will dissipate with distance. Blasting produces less noise and vibration than comparable non-blasting methods to remove hard rock. Non-blasting methods include track rig drills, rock breakers, jack hammers, rotary percussion drills, core barrels, and rotary rock drills with rock bits, which all require much longer time duration to excavate the same amount of rock as blasting.

5.7.2 Helicopter Construction

Helicopter construction techniques may be used for the erection of structures, stringing of conductor and shield wire, and other Project construction activities. The use of helicopters for structure erection is evaluated based on site- and region-specific considerations including access to structure locations, sensitive resources, permitting restrictions, construction schedule, weight of structural components, time of year, elevation, availability of heavy lift helicopters, and/or construction economics.

Helicopter erection of structures is a viable option for all locations without restrictions prohibiting or restricting helicopter use. As such “fly yards” have been incorporated into Project planning. In areas without restrictions on helicopter usage, the decision to employ helicopter construction techniques will be determined by the Contractor. However it is not anticipated that helicopter erection will be used except potentially in areas with extremely difficult access, in areas with some form of access restriction or in areas required by mitigation measures.

The use of helicopters for pulling shield wire and conductor lead lines is the normal and expected construction technique for wire stringing, as such, helicopters will be used for this purpose on the Project.

Other Project construction activities potentially facilitated by helicopters may include delivery of construction laborers, equipment, and materials to structure sites; structure placement and hardware installation. Helicopters may also be used to support the administration and management of the Project by the Applicant. Except in areas with restrictions on constructing or maintaining access roads, the use of helicopter construction methods would not change the length of the access road system required for operating the Project, because vehicle access will be required to each structure site regardless of the construction method employed.

When helicopter construction methods are employed, the structure assembly activities will be based at a fly yard. The fly yards will be approximately seven acres and will be sited typically at about five mile intervals within the section of the line employing helicopter erection. Optimum helicopter

methods of erection will be used. Bundles of steel members and associated hardware for up to 15 to 20 towers (generally to include insulators, hardware, blocking, stringing sheaves, etc.) are transported to the appropriate fly yard by truck and stored. The steel bundles are opened and laid out by component section and then assembled into assemblies of convenient size and weight according to the helicopter's lifting capabilities. The leg extensions are typically transported to the tower location, assembled, and erected in place (with smaller equipment) in preparation for flying the completed tower sections to each location. After a planned quantity of towers is completely assembled, the helicopter and support force are mobilized and, within a few days, will set all the planned towers within a given section. A follow-up crew will then tighten all the bolts in the joints.

Prior to installation, each tower would be assembled in multiple sections at the fly yard. Tower sections or components would be assembled by weight, based on the lifting capacity of the helicopter in use. The lift capacity of helicopters is dependent on the elevation of the fly yard, the tower site, and the intervening terrain. The heavy lift helicopters that could be used to erect the complete towers or sections of a tower would be able to lift a maximum of 15,000 to 20,000 pounds per flight, depending on elevation.

After assembly at the fly yard, the complete tower or tower section would be attached by cables from the helicopter to the top of the tower section and airlifted to the tower location. Upon arrival at the tower location, the section would be placed directly onto the foundation or atop the previous tower section. Guide brackets attached on top of each section would assist in aligning the stacked sections. Once aligned correctly, line crews would climb the towers to bolt the sections together permanently.

It should be noted that the fly yard locations provided are considered approximate and subject to change, additions, or deletions upon acquisition of a Contractor prior to the beginning of construction. Upon completion of field review, a final determination would be made on the necessity of certain fly yards and the respective locations that provide the most efficient, economic, safest, and least impactful use of the fly yards that are needed.

A helicopter may be used to move personnel and equipment (e.g., pulling lines and assembling towers). Helicopters will set down in areas previously identified to receive temporary disturbance such as fly yards and staging areas. Travelers may be dropped at pulling and tensioning sites or other work areas previously described. Spill protection measures will be in place and all FAA regulations will be followed. Notification will be made to coordinate the air space with other possible helicopters or aircraft in the area (i.e., seeding operations, fire support, and Military Operation Areas).

If needed, additional temporary work areas within close proximity to or on the ROW will be identified by the Contractor and approved by the appropriate land management agency or private landowner for landing and refueling the helicopter. Each fuel truck will be equipped with automatic shutoff valves and will carry spill kits. In addition to the required preventive spill measures, a water truck may be required to spray the site to reduce dust. The Contractor will be required to clean up any materials released on the ROW. Any accidental spills will be handled according to the guidelines presented in the Hazardous Materials Management Plan (Appendix L).

5.7.3 Roadless Construction Methods

The standard construction methods described in this POD are the preferred methods for the TWE Project. Under specific conditions where access road construction is restricted or prohibited such as in IRAs, roadless construction methods will be used to eliminate the need for access roads and allow all construction activities to take place with specialized techniques, vehicles, and equipment. The

roadless construction methods described in this section will be used to construct the Project in IRAs and other restricted areas.

The Applicant is not proposing to build or maintain any new temporary or permanent roads across IRAs. There will be no addition of Forest classified or temporary road miles for either construction or maintenance of the TWE Project. Where existing National Forest System roads are available and open to motor vehicle use, they will be used to access structure work areas in the TWE Project transmission line ROW. These system roads in or outside IRAs may need to be improved or widened depending on the condition of the road. However, existing roads will not be widened or otherwise upgraded for construction, as determined by the land management agency, where soils and vegetation are particularly sensitive to disturbance, except in areas where repairs are necessary to make existing roads passable and safe. Roadless construction methods include the use of helicopter construction techniques supported by minimal impact overland travel. A detailed description of helicopter construction techniques is provided in Section 5.7.2. Helicopters would transport personnel, drilling equipment, towers and other construction materials to and from the ROW and would be used for wire stringing. Access to the ROW for transport of personnel, equipment and material also could be accomplished by overland travel using low-impact vehicles. These low-impact vehicles would only be used in suitable terrain to the extent that no visible road or pathway is created. No blade work would be performed to assist overland travel within the IRAs.

Within a restricted area, the structure foundations could be constructed by several methods depending on soil conditions, terrain conditions, and final engineering design. Examples of construction options for installing tower foundations include using precast concrete support pedestals for the guyed steel lattice structures and micro-piles for the self supporting lattice tower foundations transported into the restricted area by helicopter or by overland travel using low-impact vehicles. Tower structure sections would be preassembled at approved construction fly yards located outside of the restricted areas and airlifted to the tower site locations by helicopter for erection.

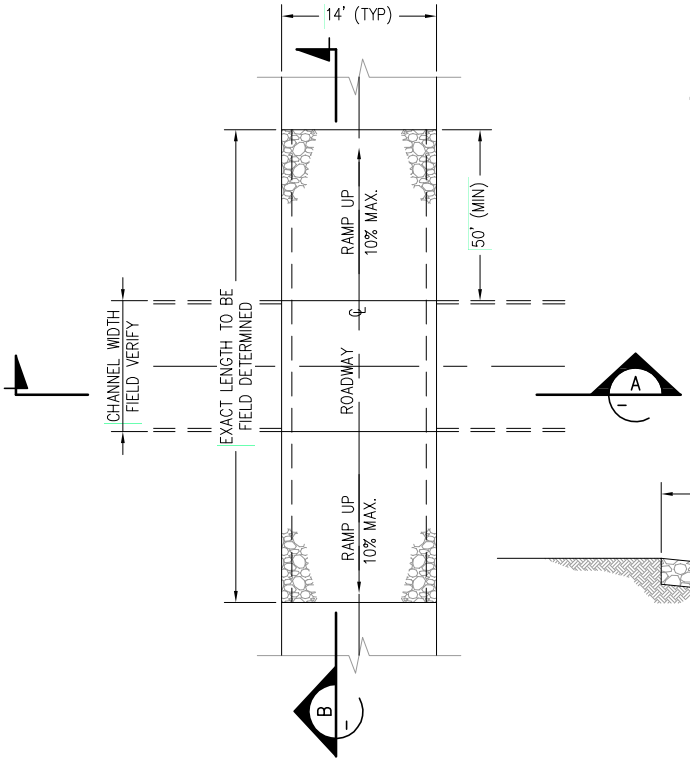
Following the completion of construction activities, any temporary disturbance, including any associated with overland travel to access the ROW would be reclaimed. The use of low-impact vehicles and equipment for overland access and ground-based site work will result in minimal disturbance in the temporary work areas. Any disturbance that does occur will be re-contoured, topsoil replaced, and revegetated with vegetation consistent with USFS requirements and the Reclamation Plan (Appendix Q). Revegetation treatments would be monitored in accordance with USFS requirements and the Reclamation Plan. Once the roadless construction area is reclaimed, routine maintenance would be via aircraft or low-impact vehicles such as vehicles with rubber treading, low pressure tires, or specialized mechanical movement to accommodate the terrain and landscape, and ATVs, or by non-motorized methods (e.g., foot, horseback, or other non-motorized methods). Unless otherwise approved, the transmission line ROW would only be accessed with motorized equipment for emergency repairs, or to maintain NESC electrical line clearances. Long-term disturbances would include maintenance of a limited ROW width, in which active vegetation management would occur. Authorization for continued vegetation management and emergency repairs would be the responsibility of the USFS and conducted in accordance with the POD and USFS stipulations.

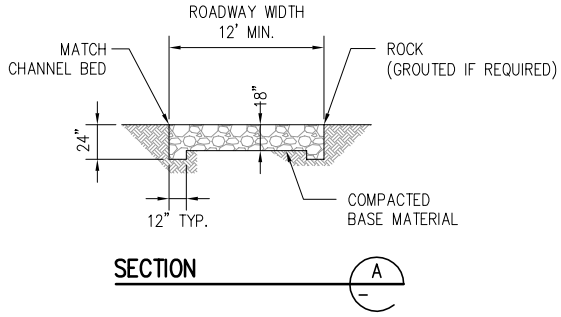
The Applicant will work with the USFS to control the use of the ROW and prevent unauthorized travel along the ROW by off-road vehicles. Measures would be determined in consultation with the USFS and may include the following: a) installing gates or other man-made physical barriers; b) creating natural barriers (e.g., large boulders or debris); and c) stockpiling trees cut for ROW clearing at barrier locations.

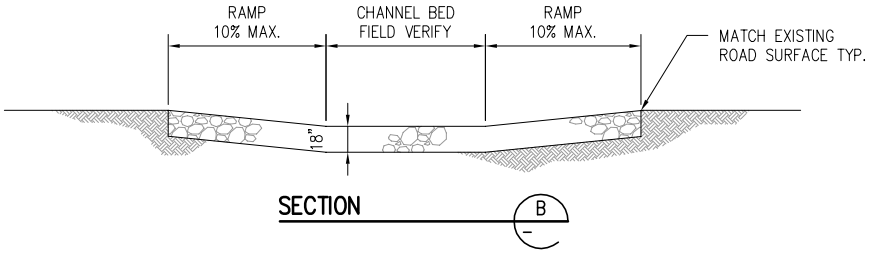
5.7.4 Water Crossings

Access roads will be designed and constructed to minimize disruption of natural drainage patterns and waterbodies including rivers, streams, ephemeral streams, ponds, lakes, reservoirs, and playas. Structure sites, new access roads, and other disturbed areas will be located away from waterbodies, wherever practicable. Each waterbody crossing will be designed in a distinct segment of the associated access roads as advanced engineering is completed. On all federally-managed lands, the Applicant will consult with the managing agency regarding relevant standards and guidelines pertaining to waterbody road-crossing methods.

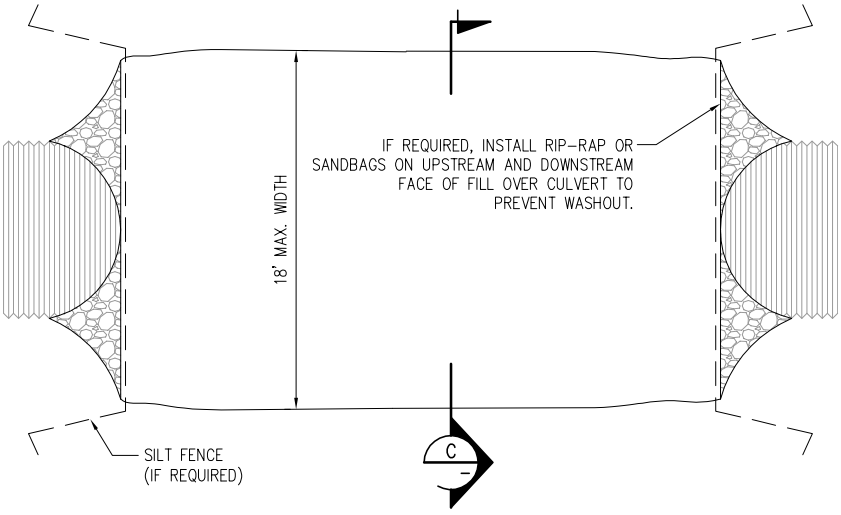
Consultation will include site assessment, design, installation, maintenance, and decommissioning of the crossings. Wherever needed, culverts, low-water crossings, and other devices of adequate accepted design will be used to accommodate estimated peak flows of waterways, including crossings of all affected perennial, intermittent, and ephemeral streams. Construction disturbances of banks and beds of waterbodies will be minimized. Performance of low water stream crossings (i.e., drive thru and ford) will be monitored for the life of the access road, and maintained as necessary to preserve water quality. Figure 18 shows typical road designs for low-water crossings and culvert stream crossings.

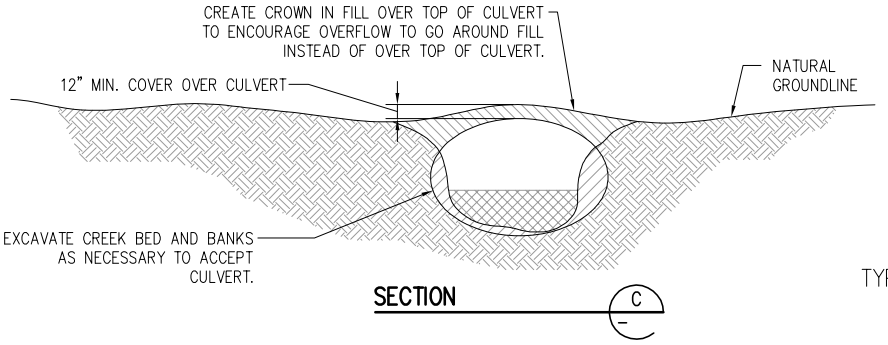






TYPICAL ROADS
CROSSING (GROUTED, IF REQUIRED)





TYPICAL ROADS – CULVERT

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 18

TYPICAL ROAD DESIGNS FOR
LOW WATER & CULVERT CROSSINGS

Potential types of water crossings that would be implemented include:

- **Drive Thru (Arizona Crossing):** Crossing of a channel with minimal vegetation removal where no cut or fill is needed. This is typical for low-precipitation sagebrush country characterized by rolling topography and streams that rarely flow with water.

- **Ford:** Crossing of a channel that includes grading and stabilization. Stream banks and approaches will be graded and stabilized with rock or other erosion control devices to allow vehicle passage. With approval of the land management agency, streambeds in select areas will be reinforced with coarse rock material to support vehicle loads, prevent erosion, and minimize sedimentation of the waterways. Coarse rock will be installed in the streambed in a manner such that it will not raise the level of the streambed, thus allowing continued movement of water, fish, and debris. A typical ford crossing results in a disturbance footprint 25 feet wide (along the waterbody) and 50 feet long (along the roadway) for 1,250 square feet or 0.03 acre of disturbed area at each crossing. The 0.03 acre is based on an estimated disturbance based on the requirement to operate equipment within the riparian area to construct a 14-foot-wide travel way and install armoring to protect it from erosion.

- **Culvert:** Crossing of a waterbody that includes installation of a culvert and construction of a stable road surface for vehicle passage over the culvert. Culverts will be designed and installed under the direction of a qualified engineer who, in collaboration with a hydrologist and an aquatic biologist where required by the land management agency, will specify placement locations; culvert gradient, height, and sizing; and proper construction methods. Culvert design will consider roadbed loading and debris size and volume. The disturbance footprint for a typical culvert installation is estimated to be 50 feet wide (along the waterbody) and 150 feet long (along the road) for 7,500 square feet or 0.17 acre of disturbed area at each crossing. This disturbed area includes approaches to the crossing and side slopes. The amount of area disturbed by excavation and fill material at each crossing will typically be much less and will be determined during final design and engineering. Ground-disturbing activities will comply with agency approved BMPs. Construction will occur during periods of low water or normal flow. The operation of construction equipment in riparian areas will be minimized. All culverts will be designed and installed to meet specified riparian conditions, as identified in applicable unit management plans. Culvert slope will not exceed stream gradient.

  Culverts will typically be partially buried in the streambed to maintain streambed material in the culvert. Sandbags or other non-erosive material will be placed around culverts to prevent scour or water flow outside the culvert. Adjacent sediment control structures such as silt fences, check dams, rock armoring, or riprap may be necessary to prevent erosion or sedimentation. Stream banks and approaches may be stabilized with rock or other erosion control devices. Culverts will be inspected annually for proper operation and maintained to preserve water quality for the life of the Project (estimated at 50 years or longer).

Wetlands will be avoided to the maximum extent practicable in siting transmission line structures, terminals, ground electrode facilities, temporary work areas, and access roads. Wetlands can typically be spanned by transmission lines to avoid impacts. Timber or other types of matting can be used to support construction equipment in wetlands to avoid the need to fill a wetland either temporarily or permanently for access during construction. Impacts to wetlands and waters of the U.S. will require a CWA Section 404 permit from USACE, NPDES Construction Stormwater Permit (Section 402), and Section 401 water quality certification.

5.7.5 Water Use

Construction of the transmission line and substation/converter stations will require water. Major water uses are required for transmission line structure and substation foundations, and dust control during ROW and substation grading and site work. A minor use of water during construction would include the establishment of substation landscaping where required.

Water usage for transmission line construction is for two primary purposes: foundation construction and dust control. In the construction of foundations, water is transported to the batch plant site where it will be used to produce concrete. From the batch plant, the wet concrete will be transported to the structure site in concrete trucks for use in foundation installation.

Construction of the transmission lines and related facilities will generate a temporary increase in fugitive dust. If the level of fugitive dust is too high in specific project areas, as determined in cooperation with the landowner or agency, water would be applied to disturbed areas to minimize dust.

Water usage for substation/converter station construction is primarily for dust control during site preparation work. During this period, construction equipment would be cutting, moving, and compacting the subgrade surface. As a result, water trucks patrolling the site to control dust would make as many as one pass per hour over the site. Once site preparation work is complete, concrete for the placement of foundations becomes the largest user of water and dust control becomes minimal.

Once site grading is complete, the balance of the substation construction work would be performed on bare subgrade soil or subgrade with a thin layer of rock. Fire risk would be minimal due to the bare ground or rock surface and would be contained within the confines of station-fenced area.

The estimated water required per mile of transmission line construction is approximately 3,400 gallons for foundation concrete and 240,000 gallons for dust control. Water required for construction of the Northern Terminal is estimated to be 600,000 gallons including dust control. Water required for construction of the Southern Terminal is estimated to be 400,000 gallons including dust control due to less disturbance and fewer foundations. Estimated water required for each ground electrode site is 150,000 gallons including dust control. The required water will be procured from municipal sources, from commercial sources, or under a temporary water use agreement with landowners holding existing water rights. No new water rights will be required.

5.8 Construction Schedule, Workforce, and Equipment

The proposed construction schedule for the TWE Project will be developed for the selected Alternative during final engineering and design and will be presented in the NTP POD. The construction schedule for the TWE Project will incorporate timing restrictions for special status plant and animal species, as determined by the land management and regulatory agencies in their respective decision documents. For purposes of the FEIS analysis, conceptual schedules have been developed, which provide general estimates on the duration of activities for each of the proposed TWE Project facilities. Conceptual construction schedules are described in Section 5.8.1. Estimated workforce and equipment needs are described in Sections 5.8.2 and 5.8.3, respectively.

5.8.1 Construction Schedule

It is anticipated that total construction timeframe for the transmission line will be approximately three years, concurrent with terminals and ground electrode system construction.

Conceptual schedules for the proposed TWE Project are shown in Figures 19, 20, 21 and 22. Figure 19 provides a bar chart construction schedule for a typical 20-mile stretch of the ±600 kV DC transmission line. Figure 20 shows the entire conceptual schedule for constructing the 750 mile long ±600 kV DC transmission line, including access roads and communication facilities. Figure 21 is a schedule for the proposed Northern and Southern Terminals, and Figure 22 is a construction schedule for the ground electrode systems.

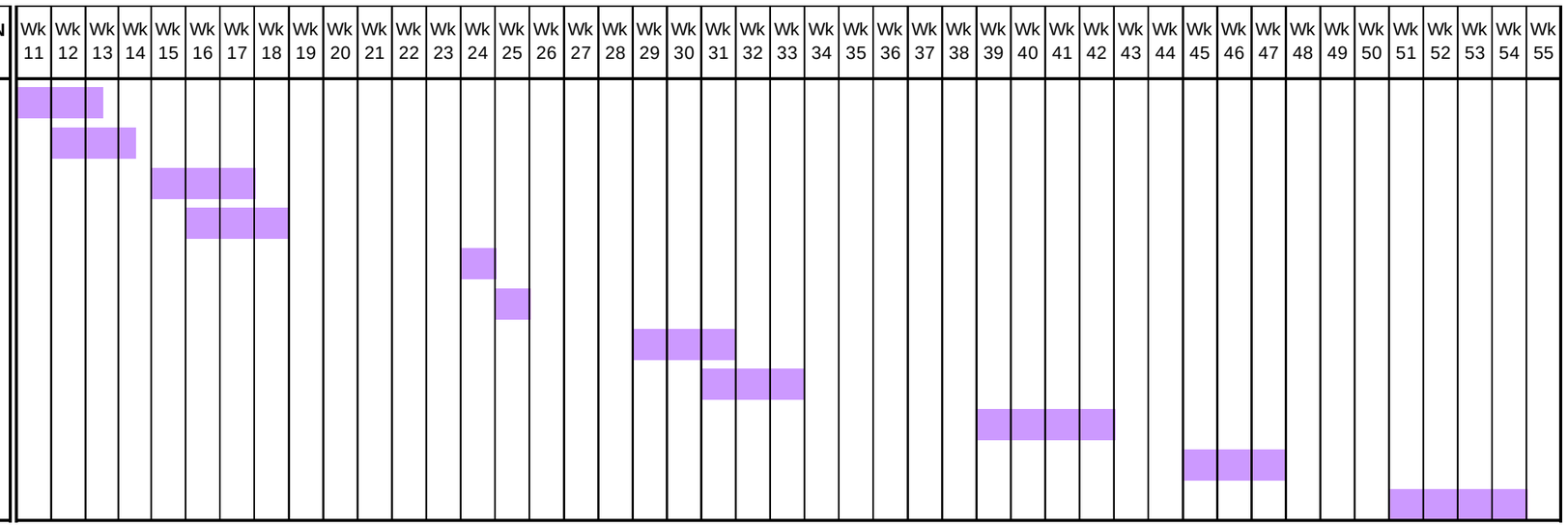
For planning purposes, the overall schedule for the transmission line has been separated into three construction spreads or operations by line segment. The transmission line schedules show a staggered start to allow time for setups, material and equipment logistics and coordination between spreads. The total elapsed time of the combined transmission line schedule is approximately 137 weeks. These construction schedules include consideration for the anticipated conditions; however, severe winter weather, delays in equipment manufacturing and/or delivery, seasonal restrictions required for permitting and/or unexpected mitigation could interrupt the schedule inserting delays of weeks to several months or more.

Construction spreads for the transmission line are anticipated at three different locations. The approximate geographic locations are: (1) Northern Terminal to North-East Utah; (2) North-East Utah to West-Central Utah; and (3) West-Central Utah to the Southern Terminal. The line construction will progress simultaneously at these locations. The construction spreads for the transmission line have been designed such that one or more Contractors may be employed to construct the complete line.

The duration of transmission line construction activities on any given parcel of land may extend up to a year, although the total amount of time of actual construction activity would be much shorter, in the range of a few months. Over any particular section of the route, transmission line construction would be characterized by short periods (ranging from a day to one to two weeks) of relatively intense activity interspersed with periods with no activity. Figure 19 illustrates the typical durations for the construction of a 20-mile section of the transmission line.

The construction of the Northern and Southern Terminals is planned to start approximately three to six months after the start of the construction of the transmission line and run concurrently. The total elapsed time is scheduled for approximately two years. These construction schedules include consideration for the anticipated conditions; however, severe winter weather at the Northern Terminal could interrupt the schedule inserting delays of weeks to several months or more. The ground electrode facilities will take approximately one year to construct and is planned to start 18 months after the start of construction of the transmission line.

TASK	DURATION (WEEKS)
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	2.5
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	2.5
GEOLOGICAL INVESTIGATIONS	3
SURVEY / STAKE STRUCTURE LOCATIONS	3
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	1
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	1
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	3
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	3
ERECT SELF SUPPORTING LATTICE STRUCTURE	4
WIRE INSTALLATION	3
FINAL CLEAN UP / RECLAMATION / RESTORATION	4



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TRANSWEST EXPRESS TRANSMISSION PROJECT

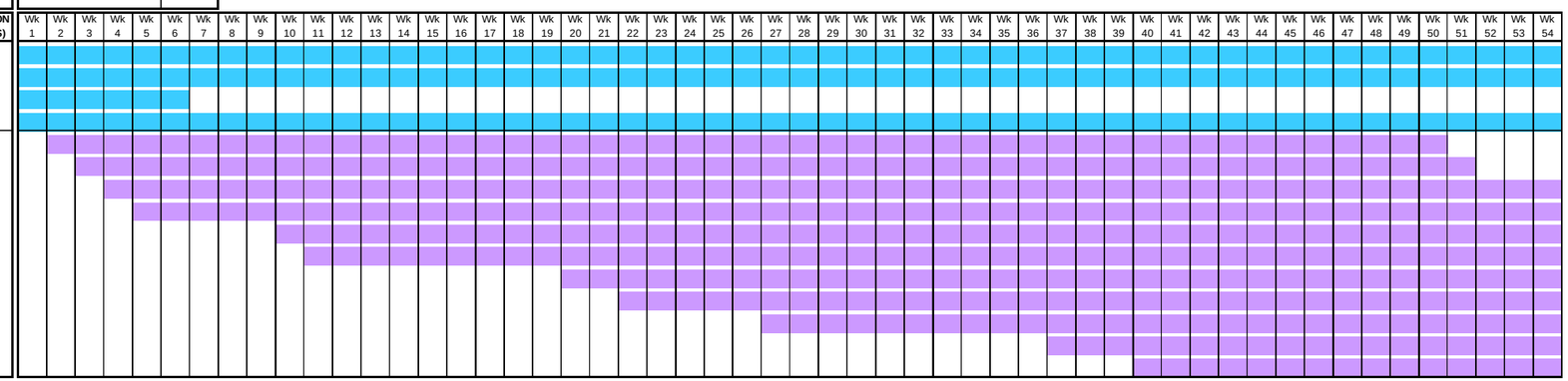
FIGURE 19

CONSTRUCTION SCHEDULE FOR 20 MILE SECTION OF ±600kV DC TRANSMISSION LINE

SECTION 1 - NORTHERN TERMINAL - NORTHEASTERN UTAH

TOTAL DURATION: 111 weeks

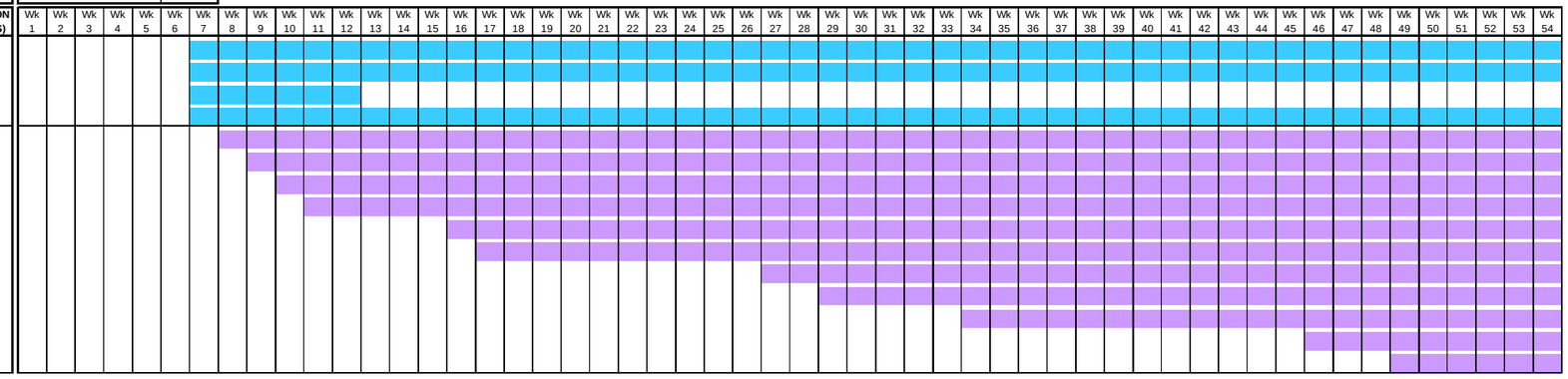
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	111
INSPECTION	109
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	109
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	56
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	67
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	67
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	60
ERECT SELF SUPPORTING LATTICE STRUCTURE	70
WIRE INSTALLATION	61
FINAL CLEAN UP / RECLAMATION / RESTORATION	70



SECTION 2 - NORTHEASTERN UTAH - WEST CENTRAL UTAH

TOTAL DURATION: 131 weeks

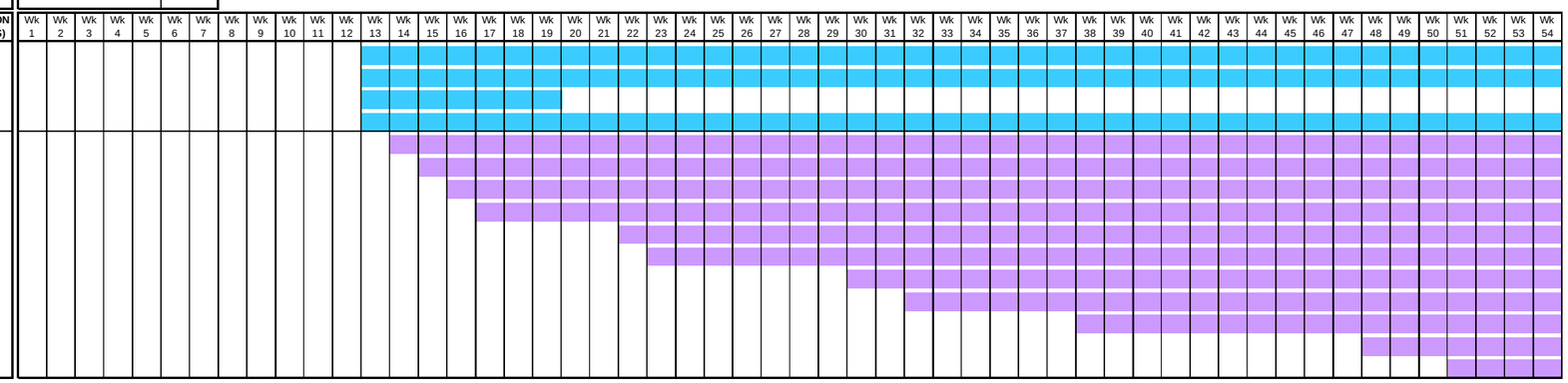
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	131
INSPECTION	129
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	129
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	60
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	60
GEOLOGICAL INVESTIGATIONS	69
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	83
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	83
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	75
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	75
ERECT SELF SUPPORTING LATTICE STRUCTURE	87
WIRE INSTALLATION	76
FINAL CLEAN UP / RECLAMATION / RESTORATION	87



SECTION 3 - WEST CENTRAL UTAH - SOUTHERN TERMINAL

TOTAL DURATION: 120 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	120
INSPECTION	118
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	118
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	56
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	56
GEOLOGICAL INVESTIGATIONS	64
SURVEY / STAKE STRUCTURE LOCATIONS	64
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	75
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	75
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	70
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	70
ERECT SELF SUPPORTING LATTICE STRUCTURE	80
WIRE INSTALLATION	70
FINAL CLEAN UP / RECLAMATION / RESTORATION	80



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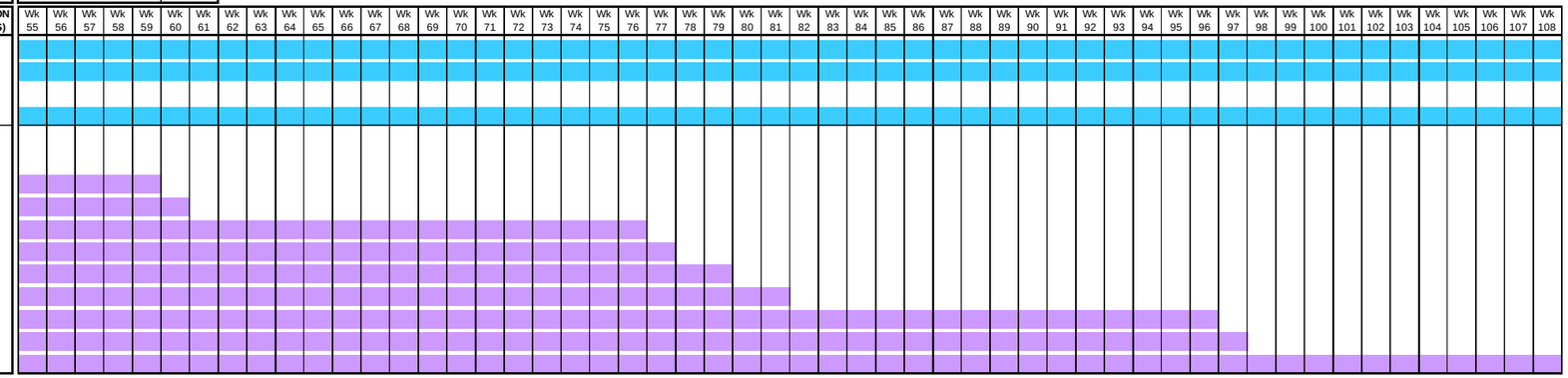
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 20

CONSTRUCTION SCHEDULE FOR
±600kV DC TRANSMISSION LINE BY SEGMENT
SHEET 1

SECTION 1 - NORTHERN TERMINAL - NORTHEASTERN UTAH

TOTAL DURATION: 111 weeks

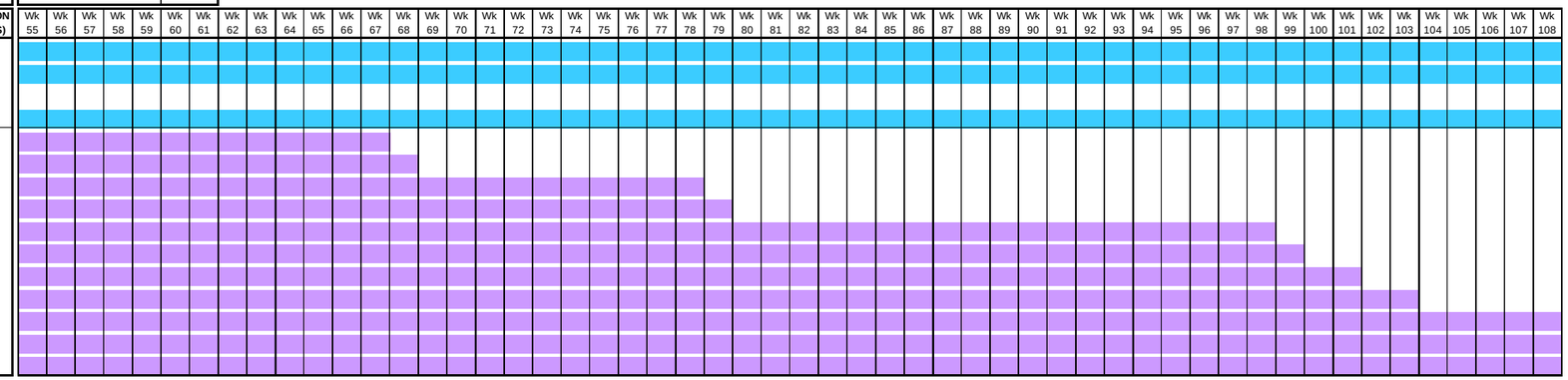
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	111
INSPECTION	109
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	109
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	56
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	67
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	67
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	60
ERECT SELF SUPPORTING LATTICE STRUCTURE	70
WIRE INSTALLATION	61
FINAL CLEAN UP / RECLAMATION / RESTORATION	70



SECTION 2 - NORTHEASTERN UTAH - WEST CENTRAL UTAH

TOTAL DURATION: 131 weeks

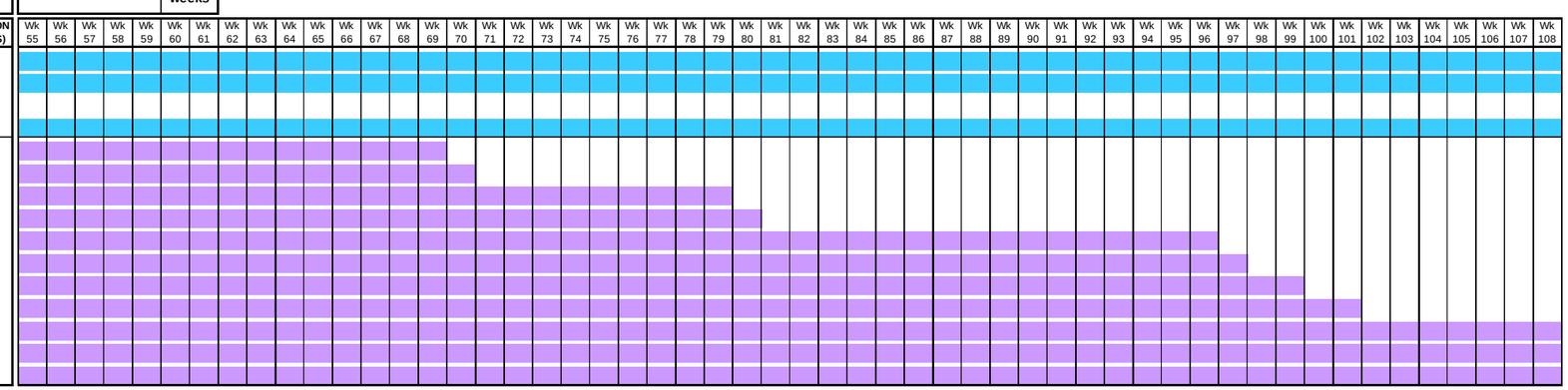
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	131
INSPECTION	129
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	129
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	60
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	60
GEOLOGICAL INVESTIGATIONS	69
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	83
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	83
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	75
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	75
ERECT SELF SUPPORTING LATTICE STRUCTURE	87
WIRE INSTALLATION	76
FINAL CLEAN UP / RECLAMATION / RESTORATION	87



SECTION 3 - WEST CENTRAL UTAH - SOUTHERN TERMINAL

TOTAL DURATION: 120 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	120
INSPECTION	118
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	118
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	56
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	56
GEOLOGICAL INVESTIGATIONS	64
SURVEY / STAKE STRUCTURE LOCATIONS	64
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	75
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	75
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	70
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	70
ERECT SELF SUPPORTING LATTICE STRUCTURE	80
WIRE INSTALLATION	70
FINAL CLEAN UP / RECLAMATION / RESTORATION	80



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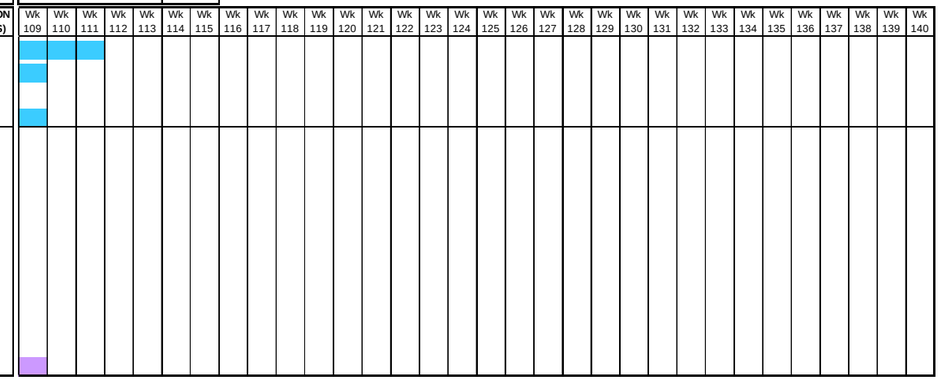
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 20

CONSTRUCTION SCHEDULE FOR
±600kV DC TRANSMISSION LINE BY SEGMENT
SHEET 2

SECTION 1 - NORTHERN TERMINAL - NORTHEASTERN UTAH

TOTAL DURATION: 111 weeks

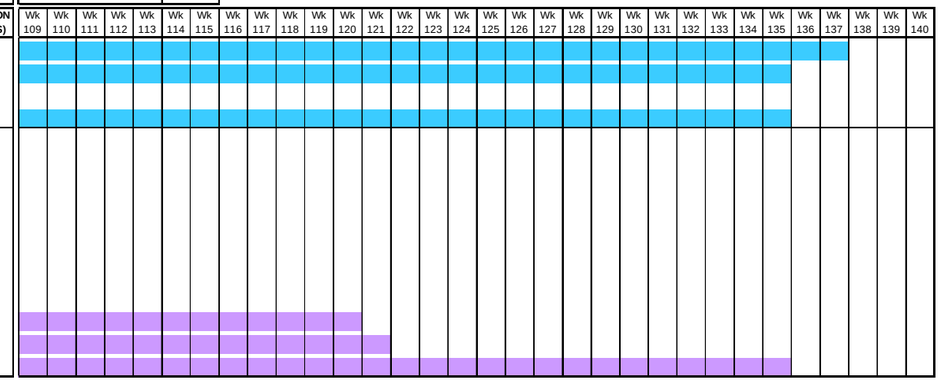
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	111
INSPECTION	109
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	109
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	56
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	67
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	67
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	60
ERECT SELF SUPPORTING LATTICE STRUCTURE	70
WIRE INSTALLATION	61
FINAL CLEAN UP / RECLAMATION / RESTORATION	70



SECTION 2 - NORTHEASTERN UTAH - WEST CENTRAL UTAH

TOTAL DURATION: 131 weeks

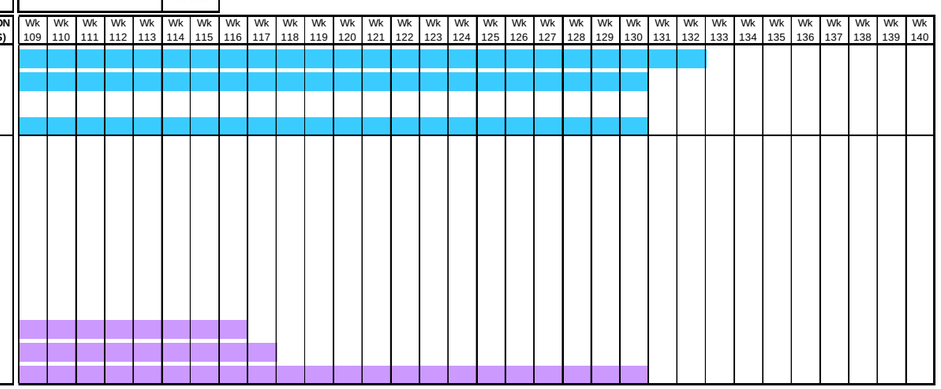
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	131
INSPECTION	129
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	129
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	60
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	60
GEOLOGICAL INVESTIGATIONS	69
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	83
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	83
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	75
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	75
ERECT SELF SUPPORTING LATTICE STRUCTURE	87
WIRE INSTALLATION	76
FINAL CLEAN UP / RECLAMATION / RESTORATION	87



SECTION 3 - WEST CENTRAL UTAH - SOUTHERN TERMINAL

TOTAL DURATION: 120 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	120
INSPECTION	118
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	118
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	56
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	56
GEOLOGICAL INVESTIGATIONS	64
SURVEY / STAKE STRUCTURE LOCATIONS	64
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	75
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	75
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	70
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	70
ERECT SELF SUPPORTING LATTICE STRUCTURE	80
WIRE INSTALLATION	70
FINAL CLEAN UP / RECLAMATION / RESTORATION	80



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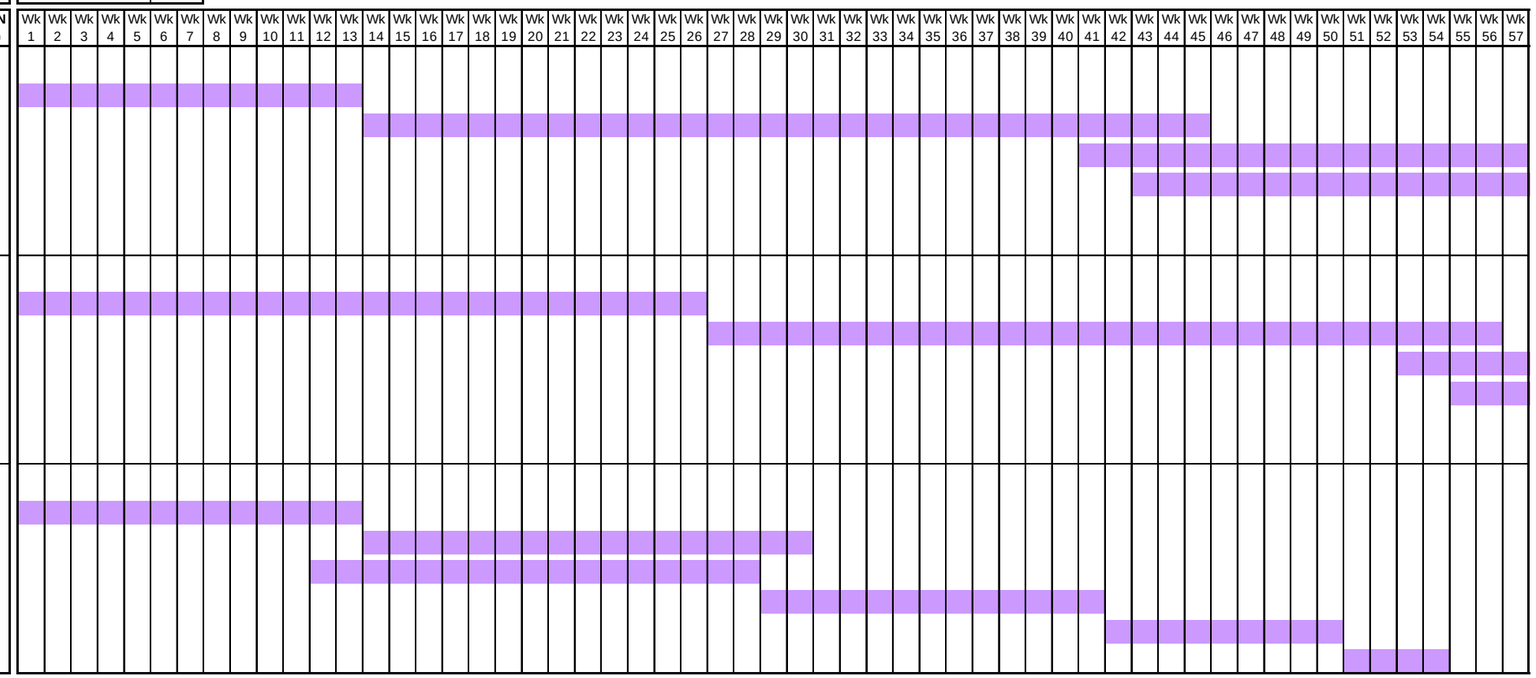
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 20

CONSTRUCTION SCHEDULE FOR
±600kV DC TRANSMISSION LINE BY SEGMENT
SHEET 3

NORTHERN TERMINAL

TOTAL DURATION: 111 week

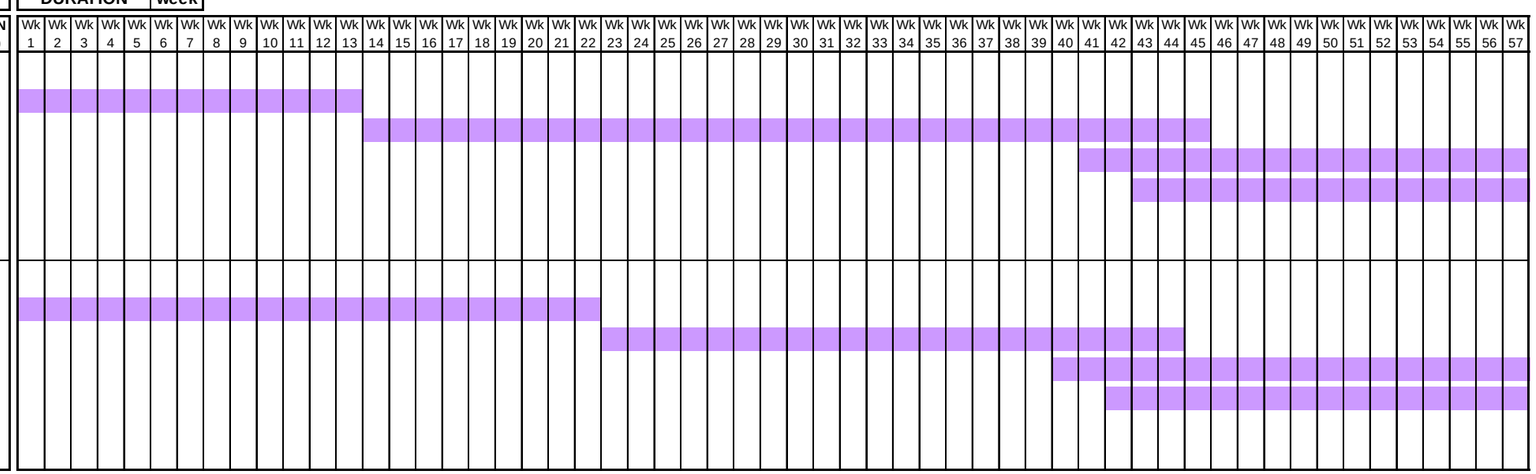
TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	26
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	30
BUILDING CONSTRUCTION	34
EQUIPMENT INSTALLATION	30
EQUIPMENT TESTING	17
OPERATIONAL	7
230 kV AC SUBSTATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	17
BUILDING CONSTRUCTION	17
EQUIPMENT INSTALLATION	13
EQUIPMENT TESTING	9
OPERATIONAL	4



SOUTHERN TERMINAL

TOTAL DURATION: 111 week

TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
BUILDING CONSTRUCTION	26
EQUIPMENT INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	6



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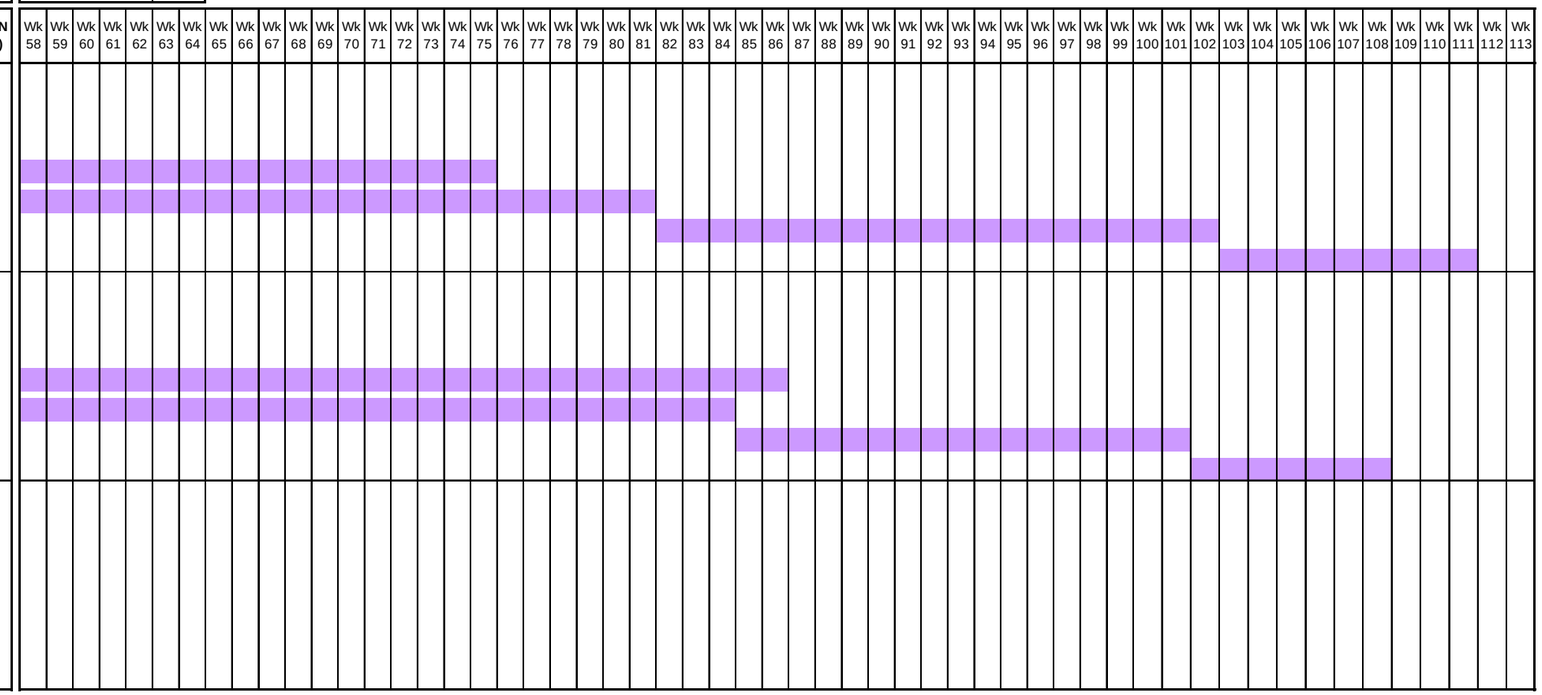
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 21
CONSTRUCTION SCHEDULE FOR NORTHERN & SOUTHERN TERMINALS
SHEET 1

NORTHERN TERMINAL

TOTAL DURATION	111 week

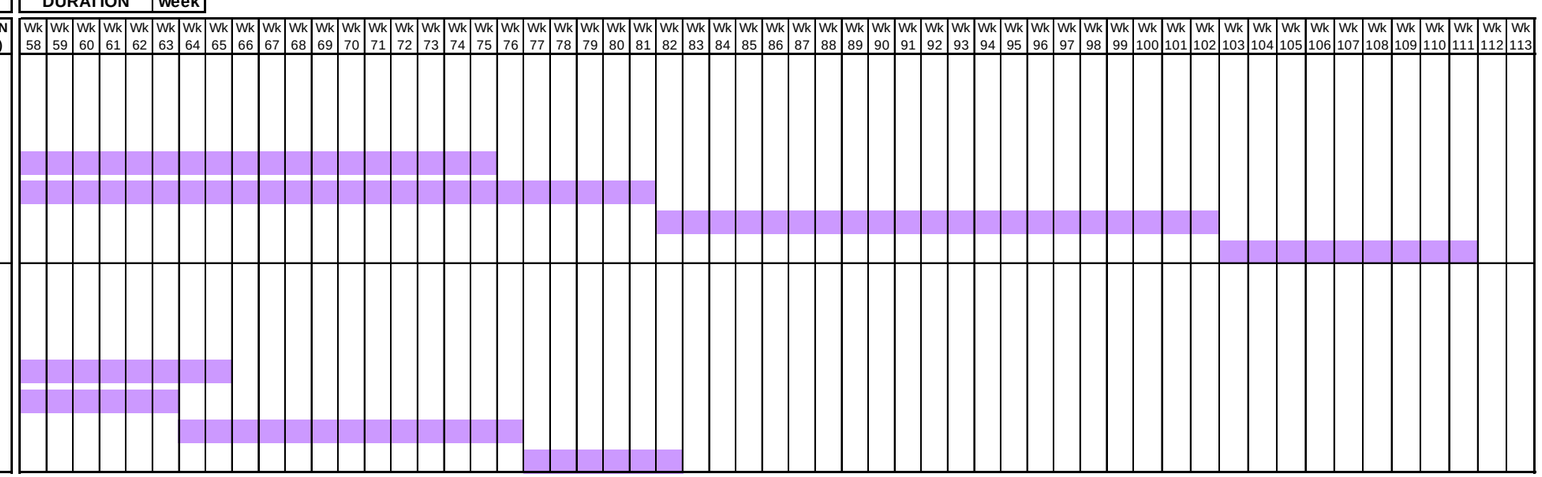
TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	26
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	30
BUILDING CONSTRUCTION	34
EQUIPMENT INSTALLATION	30
EQUIPMENT TESTING	17
OPERATIONAL	7
230 kV AC SUBSTATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	17
BUILDING CONSTRUCTION	17
EQUIPMENT INSTALLATION	13
EQUIPMENT TESTING	9
OPERATIONAL	4



SOUTHERN TERMINAL

TOTAL DURATION	111 week

TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500 kV AC SUBSTATION	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
BUILDING CONSTRUCTION	26
EQUIPMENT INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	6



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 21
CONSTRUCTION SCHEDULE FOR
NORTHERN & SOUTHERN TERMINALS
SHEET 2

CONSTRUCTION SCHEDULE FOR ONE GROUND ELECTRODE LOCATION

TASK	DURATION (WEEKS)	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	Wk 20	Wk 21	Wk 22	Wk 23	Wk 24	Wk 25	Wk 26	Wk 27	Wk 28	Wk 29	Wk 30	Wk 31	Wk 32	Wk 33	Wk 34	Wk 35	Wk 36	Wk 37	Wk 38
SITE GRADING	3	■	■	■																																			
DRILLING 60 WELLS	8					■	■	■	■	■	■	■	■																										
EXCAVATE CABLE TRENCHES	6					■	■	■	■	■	■																												
BUILD CONCRETE CABLE TRENCHES	10							■	■	■	■	■	■	■	■	■	■																						
INSTALL ELECTRODE ELEMENTS	8						■	■	■	■	■	■	■	■																									
INSTALL LV CABLES, SWITCHES	4																					■	■	■	■														
INSTALL TEMPERATURE & CURRENT TRANSDUCERS, WIRING	2																							■	■														
BUILD CONTROL / COMMUNICATION BUILDING & FENCED AREA	8					■	■	■	■	■	■	■	■																										
INSTALL SITE COMMUNICATIONS EQUIPMENT, SCADA	4																										■	■	■	■									
ELECTRODE COMMISSIONING*	8																															■	■	■	■	■	■	■	■

*PERFORMED AFTER CONVERTER STATIONS ARE FUNCTIONAL

CONSTRUCTION SCHEDULE FOR LOW VOLTAGE TRANSMISSION LINE (10 MILES ASSUMED)

TASK	DURATION (WEEKS)	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	Wk 20	Wk 21	Wk 22	Wk 23	Wk 24	Wk 25	Wk 26	Wk 27	Wk 28	Wk 29	Wk 30	Wk 31	Wk 32	Wk 33	Wk 34	Wk 35	Wk 36	Wk 37	Wk 38
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	3	■	■	■																																			
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	4			■	■	■	■																																
FOUNDATION EXCAVATION	3						■	■	■																														
HAUL STRUCTURES	3								■	■	■																												
INSTALL STRUCTURES	4									■	■	■	■																										
INSTALL WIRES	2												■	■																									
FINAL CLEAN UP / RECLAMATION / RESTORATION	4														■	■	■	■																					

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 22
CONSTRUCTION SCHEDULE FOR GROUND ELECTRODE FACILITIES

5.8.2 Construction Workforce

The proposed TWE Project will be constructed by contract personnel, with the Applicant responsible for Project management, Project administration, and inspection. The construction workforce will consist of laborers, craftsmen, supervisory personnel, support personnel, and construction management personnel who will perform the construction tasks. Estimated construction workforce requirements by major activity are summarized in Tables 10 and 11.

Table 10 identifies the estimated personnel and equipment that is required for each of the three transmission line spreads. The total estimated number of construction personnel for construction of the entire transmission line is 630 people. Table 11 identifies the estimated personnel and equipment that is required for each of the two terminals and each of the two ground electrodes. The total estimated number of construction personnel for construction of both terminals and both ground electrodes is 360 people. The total estimated workforce for the complete proposed Project is approximately 1,000 people.

Construction will generally occur between 7 a.m. and 7 p.m., Monday through Saturday. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities.

Temporary work camps are not expected to be necessary for the construction of the TWE Project. Variables considered in determining if work camps would be required are:

- The total distance between living facilities for construction workers and designated work areas. A general one-way travel time of two hours may be considered as a limit in determining if temporary work camps are necessary.
- Workers' Union wage agreement regarding the driving time one-way (to worksite) or round trip (to/from worksite). If the agreement allows for driving time then the camp consideration may not be required.
- The ability of existing communities to provide housing for workers or to make improvements to meet the workers' accommodation demands.
- Socioeconomic impacts on communities along the route with or without the work camps.
- Economic feasibility of permitting a work camp.
- Service life of the work camps and the restoration requirements after tear down.

The TWE Project does not appear to have areas that are more than 50 miles (on paved roads) from the ROW to existing communities or towns. The average travel distance for the Project is approximately 15 miles. The populations of these towns indicate their capability to handle the housing and/or accommodation demands of the construction workers. It should be noted during typical transmission line construction, the entire work force and support personnel generally do not all work in one area at any given time. Generally one or more activities are completed and the associated crews move to a new location prior to all the other activities becoming fully operational in that area.

5.8.3 Construction Equipment

Equipment required for construction of the TWE Project transmission lines, terminals and ground electrode facilities will include, but is not limited to, that listed in Tables 10 and 11.

TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD

ACTIVITY	PEOPLE	QUANTITY	TYPE OF EQUIPMENT	TRACK OR RUBBER TIRES
Survey Crew	6	2	Pickup trucks	Rubber
		2	ATV	Rubber
Geologic/ Geotechnical Investigations	6	2	Pickup trucks, 4-wheel drive	Rubber
		1	ATV	Rubber
		2	Rubber tire drill trucks (2-ton)	Either (should change description)
Road Construction Crew	6	2	Dozer (D-8 Cat or equivalent)	Track
		1	Motor grader	Rubber
		1	Pickup truck	Rubber
		2	Carry alls	Rubber
		1	Water truck (for construction and maintenance)	Rubber
		1	Dump truck	Rubber
		1	Front end loader	Either
		1	Diesel tractor w/lowboy	Rubber
Foundation Installation Crew	26	4	Hole diggers	Either
		2	Dozers	Either
		2	Trucks (2-ton)	Rubber
		2	Trucks, flatbed, w/boom (5-ton)	Rubber
		4	Concrete trucks	Rubber
		2	Dump trucks	Rubber
		2	Diesel tractors (equipment hauling)	Rubber
		3	Pickup trucks	Rubber
		1	Mechanics truck	Rubber
		1	Water truck	Rubber
		1	Carry all	Rubber
		2	Cranes, all terrain (35-ton)	Either
		1	Front end loader	Either
		1	Backhoe, w/bucket	Rubber
		1	Wagon drill	Either
		3	Equipment-tool trailers	Rubber
Anchor Installation	20	2	Pickup trucks	Rubber
		4	Carry alls	Rubber

ACTIVITY	PEOPLE	QUANTITY	TYPE OF EQUIPMENT	TRACK OR RUBBER TIRES
		1	Truck, flatbed (2-ton)	Rubber
		2	Trucks, flatbed, w/boom (5-ton)	Rubber
		1	Dump truck	Rubber
		1	Water truck	Rubber
		2	Concrete trucks	Rubber
		1	Mechanics truck	Rubber
		2	Diesel tractors, w/lowboy	Rubber
		2	Dozers	Track
		1	Loader, front end	Either
		3	Backhoes, w/bucket	Either
		3	Wagon drills	Either
		3	Cranes, all terrain (35-ton)	Either
Structure Steel Haul Crew	8	1	Equipment-tool trailer	Rubber
		2	Diesel tractors (steel hauling)	Rubber
		1	Pickup truck	Rubber
		1	Truck, flatbed (2-ton)	Rubber
		1	Carry all	Rubber
		5	Cranes, all terrain (35-ton)	Either
		3	Fork lifts	Rubber
Structure Assembly Crews 8-9 Crews	72	2	Pickup trucks	Rubber
		10	Carry alls	Rubber
		5	Cranes, all terrain (35-ton)	Either
		1	Water truck	Rubber
		5	Air compressors	Rubber
		2	Trucks (2-ton)	Rubber
		1	Mechanics truck	Rubber
		2	Tool-equipment trailers	Rubber
Structure Erection Crews 1-2 Crews	20	2	Cranes (120 – 300-ton)	Either
		2	Trucks (2-ton)	Rubber
		2	Pickup trucks	Rubber
		5	Carry alls	Rubber
		1	Mechanics truck	Rubber
		2	Air compressors	Rubber

ACTIVITY	PEOPLE	QUANTITY	TYPE OF EQUIPMENT	TRACK OR RUBBER TIRES
		1	Tool-equipment trailer	Rubber
Wire Installation Crew	36	6	Wire reel trailers	Rubber
		4	Haul trailers	Rubber
		4	Diesel tractors	Rubber
		4	Cranes (2) 20-ton, (2) 30-ton	Either
		5	Trucks, flatbed, w/bucket (5 -ton)	Rubber
		4	Pickup trucks	Rubber
		2	Splicing trucks	Rubber
		2	3-drum pullers (one medium, one heavy)	Rubber
		2	Single drum pullers (large)	Rubber
		1	Backhoe, w/bucket	Rubber
		1	Water truck	Rubber
		2	Trucks, flatbed (2-ton)	Rubber
		4	Double bull-wheel tensioner (two light and two heavy)	Rubber
		2	Sagging equipment (D-8 Cat)	Track
		6	Carry alls	Rubber
		2	Static wire reel trailers	Rubber
		3	Tool-equipment trailers	Rubber
		2	Mechanics trucks	Rubber
Clean-up Crew	4	1	Truck, flatbed, w/bucket (5-ton)	Rubber
		1	Pickup truck	Rubber
		1	Carry all	Rubber
Road Rehabilitation Crew (ROW Restoration)	6	1	Dozer (D-8 Cat or equivalent)	Track
		1	Front end loader w/bucket	Either
		1	Backhoe, w/bucket	Either
		1	Diesel tractor, w/lowboy	Rubber
		1	Seeding/harrowing equipment, w/tractor	Either
		1	Motor grader	Rubber
		1	Pickup truck	Rubber
		1	Dump truck	Rubber
		1	Carry all	Rubber

Estimated maximum personnel required for all transmission line tasks including maintenance, management, and quality control personnel = 210 for each of the three spreads.

TABLE 11 ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE FACILITIES

ACTIVITY	PEOPLE	QUANTITY	TYPE OF EQUIPMENT	TRACK OR RUBBER TIRE
Survey Crew	4	2	Pickup trucks	Rubber
Site Management Crew	10-12	4	Office trailers	Rubber
		4	Pickups	Rubber
		4	Generators	Rubber
Site Development – Civil Work Crew	30-35	4	Scrapers	Rubber
		2	Dozers (ripper)	Track
		2	Motor graders	Rubber
		2	Roller compactors	Rubber
		2	Excavators	Either
		4	Dump trucks	Rubber
		3	Water trucks	Rubber
		1	Mechanics truck	Rubber
		1	Fuel truck	Rubber
		2	Pickup trucks	Rubber
		6	Carry alls	Rubber
Fence Installation Crew	10-20	1	Pickup truck	Rubber
		1	Boom truck	Rubber
		2	Carry alls	Rubber
		1	Backhoe	Either
		1	Concrete truck	Rubber
		1	Reel stand truck	Rubber
		2	Bobcats	Either
Equipment Footings Installation Crew	24-30	2	Hole diggers	Either
		2	Boom trucks	Rubber
		1	Excavator	Either
		3	Concrete trucks	Rubber
		1	Dump truck	Rubber
		1	Roller compactor	Rubber
		2	Plate compactors	----------
		1	Backhoe	Either
		2	Bobcats	Either
		1	Mechanics truck	Rubber

ACTIVITY	PEOPLE	QUANTITY	TYPE OF EQUIPMENT	TRACK OR RUBBER TIRE
		1	Fuel truck	Rubber
		1	Water truck	Rubber
		2	Pickup trucks	Rubber
		4	Carry alls	Rubber
Cable Trench, Conduits, and Station Grounding Crew	12-16	2	Trenchers	Either
		2	Dozers (ripper)	Track
		2	Roller compactors	Rubber
		2	Plate compactors	----------
		2	Excavators	Either
		1	Boom truck	Rubber
		3	Pickup trucks	Rubber
		2	Flatbed trucks	Rubber
		4	Carry alls	Rubber
		1	Air compressor	Rubber
		1	Backhoe	Either
		1	Mechanics truck	Rubber
		1	Fuel truck	Rubber
		1	Dump truck	Rubber
		1	Reel stand truck	Rubber
Steel Structure and Bus Installation Crew, Converter Valve Hall, Ancillary Buildings Construction Crew, Equipment Assembly and Erection Crew	16-24	2	Cranes, RT	Either
		2	High capacity cranes	Either
		4	Boom trucks	Either
		6	Manlifts	Either
		4	Welder trucks	Rubber
		2	Carry alls	Rubber
		3	Pickup trucks	Rubber
		2	Flatbed trucks	Rubber
		1	Mechanics truck	Rubber
		4	Vans	Rubber
		2	Flatbed trucks	Rubber
Control Building and Wiring Crew	20-24	2	Boom trucks	Rubber
		4	Manlifts	Either
		3	Wire pullers-small	Rubber
		2	Reel stand trucks/trailers	Rubber

ACTIVITY	PEOPLE	QUANTITY	TYPE OF EQUIPMENT	TRACK OR RUBBER TIRE
		4	Vans	Rubber
		4	Pickup trucks	Rubber
		2	Carry alls	Rubber
		1	Splicing van	Rubber
		2	Concrete trucks	Rubber
		1	Bobcat	Either
		1	Trencher	Either
		2	Plate compactors	----------
Ground Electrode Construction Crew	12-18	2	Pickup trucks	Rubber
		1	Fuel truck	Rubber
		1	Water truck	Rubber
		2	Trenchers	Either
		2	Drill rigs	Either
		1	Boom truck	Rubber
		2	Flatbed trucks	Rubber
		1	Bobcat	Either
		1	Backhoe	Rubber
		1	Mechanics truck	Rubber
		1	Concrete trucks	Rubber
		1	Air compressor	Rubber

The above table reflects estimated personnel requirements, which may reach as high as 180 for each terminal, substation, and ground electrode construction, including maintenance, management, and quality control personnel.

6.0 OPERATION AND MAINTENANCE

The TWE Project ±600 kV DC, 500 kV AC and 230 kV AC transmission lines, terminals, substations, ground electrode facilities, communications system, and other ancillary facilities will comprise critical infrastructure of the Desert Southwest transmission systems and of the western U.S. electrical grid. Limiting the duration of unplanned outages, and planning for the use of live-line maintenance techniques to minimize the requirement for and duration of outages is an important part of the design, construction, and operation/maintenance requirements for this Project.

Regular inspection of transmission lines, terminals, substations, ground electrodes, and support systems is critical for safe, efficient, and economical operation of the Project. Regular ground and aerial inspections will be performed in accordance with the Applicant's established policies and procedures for transmission line inspection and maintenance (Western 2007). The TWE Project ±600 kV DC, 500 kV AC and 230 kV AC transmission lines, terminals, substations, ground electrode facilities, communications system, and other ancillary facilities will be inspected regularly for corrosion, equipment misalignment, loose fittings, vandalism, and other mechanical problems. The need for vegetation management on transmission line ROWs will also be determined during inspection patrols. A detailed Operations and Maintenance Plan is included in Appendix O.

This section includes a discussion of compatible uses, ROW safety requirements, inspection, maintenance and repair, emergency response and decommissioning practices.

6.1 Compatible Uses

Transmission lines are designed and constructed to meet or exceed the requirements of the National Electrical Safety Code. These standards provide for the safety and protection of landowners and their property, the public, and utility employees. After construction, compatible uses in the ROW will be considered and approved by TransWest, BLM or other land management agency depending on the land ownership.

For private lands, compatible uses are determined in accordance with the terms and conditions of the easement for the TWE Project with the property owner. Ranching and farming activities, gardening, recreational activities, and other uses are generally permitted in the easement as long as care is taken to prevent damage and maintain access to transmission line structures. No buildings or structures may be erected in the easement because they could impede the safe operation of the line or interfere with maintenance access. For safety reasons, pumps, wells, swimming pools, and flammables must not be placed in the easement area. Properly grounded and permitted irrigation systems are acceptable.

For public lands, BLM retains the right to require common use of a ROW, including subsurface and air space, and authorize use of the ROW for compatible uses (43 CFR §2805.15(b)). If BLM receives an application for a grant of land subject to TransWest's ROW Grant or near or adjacent to it, the BLM will notify TransWest in writing when it receives a grant application. BLM will consider TransWest's written recommendations as to how the proposed use affects the integrity of, or TransWest's ability to operate, its facilities. The notice will contain a time period within which TransWest must respond. The notice may also notify TransWest of additional opportunities to comment (43 CFR §2807.14).

Other federal and state agencies have their own rules and regulations concerning compatible uses of ROW. These rules and regulations as applicable will be incorporated into the terms and conditions of any special use permits, licenses or ROW issued for the TWE Project.

6.2 Right-of-Way Safety Requirements

The design, operation, and maintenance of the TWE Project will meet or exceed applicable criteria and requirements outlined by the FERC, WECC, NESC, and U.S. Department of Labor, Occupational Safety and Health Standards (OSHA) for the safety and protection of landowners, their property, and the general public. The transmission line will be protected with power circuit breakers and line relay protection equipment. If a conductor or component failure occurs, power will be automatically removed from the line. Lightning protection will be provided by overhead shield wires on the top of the line. Where vegetation presents a potential hazard, trees will be trimmed or cut to prevent accidental grounding contact with conductors.

The ±600 kV DC transmission line presents no risk of inducing line currents due to the static nature of the DC electrical and magnetic fields. In comparison, AC transmission systems can induce currents. As described below in Section 6.2.2, mitigation measures for AC inductive currents would be implemented for the AC transmission lines associated with the TWE Project or for Design Options 2 and 3.

6.2.1 Building and Fence Grounding

As part of the proposed TWE Project, short distances (five miles or less) of AC transmission lines will be constructed between the TWE Project substations and the existing and planned regional AC transmission system. In order to mitigate possible electric shock caused by electrostatic and electromagnetic AC induction, all buildings, fences, and other structures with metal surfaces located within 300 feet of the centerline of the ROW will be grounded to the mutual satisfaction of the parties involved. Typically, residential buildings located 300 feet or further from the centerline will not require grounding. Other buildings or structures outside of the ROW will be reviewed in accordance with the NESC to determine grounding requirements. All metal irrigation systems and fences that parallel the transmission line for distances of 500 feet or more, within 300 feet of the centerline will be grounded. All fences that cross under the transmission line also will be grounded. This procedure will be included in the construction specifications, and if grounding is required outside the ROW, agency and landowner consent will be obtained as necessary.

6.2.2 Induced Currents on Adjacent Facilities from AC Transmission Lines

Railroads

When a high voltage transmission line is located adjacent to a railroad, the tracks and signals may be subjected to electrical interference from electric and magnetic induction, conductive interference, and capacitive effects. Capacitive coupling results from the electric field from the transmission lines' conductors coupling with above ground conductive objects that are insulated from the earth, such as railroad tracks that are typically installed on high impedance ballast (the rock bed used to support the tracks). Electric and magnetic induction results from the magnetic field produced by the AC flowing in the conductors of the transmission line coupling with above ground and below ground metallic objects, such as railroad tracks and buried communications cables. If a transmission line is located in proximity and parallel to a railroad for long distances, these interference mechanisms can cause high currents and voltages to develop on the tracks and communication cables. If the AC interference is above certain thresholds, it can result in personal safety hazards, damage to signal and communication equipment, and false signaling of equipment.

These AC interference effects can be predicted with computer modeling. With proper planning and mitigation management, railroads and high voltage AC transmission lines can be safely co-located. The American Railway Engineering and Maintenance-of-Way Association has specifications for

steady state rail-to-ground and equipment-to-ground voltage levels to ensure safety of railway operating personnel and the public. During fault conditions the safety criteria established by the ANSI/IEEE (Institute of Electrical and Electronics Engineers) Standard 80 (Guide for Safety in AC Substation Grounding) is used. In addition, railroad signal and equipment manufacturers provide AC interference voltage tolerances for proper signal operation so that nearby transmission facilities can be designed to ensure that AC interference levels do not exceed the acceptable safety criteria or equipment voltage tolerance.

Depending on AC interference levels, several mitigation methods may be used. These include increasing the distance between the transmission line and the railroad tracks, reducing the distance between insulated joints in track sections, grounding the railroad's tracks, and burying gradient control wires or matting.

For locations where the final alignment of an AC section of transmission line is in close proximity to a railroad for long distances, the Applicant, during detailed design, would perform computer modeling of potential AC interference effects to design and implement required mitigation to be installed prior to energizing the transmission line.

Pipelines

When a high voltage transmission line is located adjacent to a pipeline ROW, the pipeline may be subjected to electrical interference from electric and magnetic induction, conductive interference, and capacitive effects. Electric and magnetic induction is the primary effect of the high voltage AC transmission line on a buried pipeline during normal (steady-state) operation. This form of interference is due to the magnetic field produced by the AC current flowing in the conductors of the transmission line coupling with the metallic pipeline, inducing a voltage and associated current on the pipeline.

Conductive interference is a concern when a transmission line fault occurs in proximity to the pipeline, because it can cause AC currents to enter the pipeline at coating holidays (flaws in the coating) and produce a voltage gradient across the pipeline coating. Electric and magnetic effects are also a concern during a fault because the phase current in at least one phase (conductor) of the high voltage AC transmission line is elevated.

If these electrical interference effects are great enough during normal operation, then a potential shock hazard exists for anyone that touches an above ground part of the pipeline, such as a valve or cathodic protection test station. In addition, during normal operation, if the induced AC current density at a flaw in the pipeline coating is great enough, AC pipeline corrosion may occur. Lastly, damage to the pipeline coating can occur if the voltage between the pipeline and surrounding soil becomes excessive during a fault condition.

With proper planning and mitigation, pipelines and high voltage AC transmission lines can be safely co-located. The AC interference effects can be easily predicted with computer modeling. The National Association of Corrosion Engineers has standards that ensure that pipeline integrity would not be degraded nor personnel safety compromised because of AC interference from a transmission line constructed and operated adjacent to a pipeline.

Mitigation techniques for AC interference on pipelines include reducing the impedance of the transmission structure grounds, grounding the pipeline in conjunction with de-couplers, burying gradient control wires along the pipeline or burying ground mats under aboveground facilities (such as valves) and using dead fronts at test stations.

The TWE Project configured as an overhead AC transmission line can be located in its 250 foot ROW adjacent to the ROW for buried underground high pressure natural gas and other petroleum pipelines as long as proper grounding and cathodic protection systems are utilized for the pipeline. The TWE Project however, may not be sited in the same ROW as an underground pipeline regardless of whether the TWE Project is a DC or AC line. For locations where the final alignment of an AC section of transmission line is in close proximity to a pipeline, the Applicant, during detailed design, would ensure that computer modeling of AC interference effects is completed and that any required mitigation is designed and installed prior to energizing the transmission line.

6.3 Transmission Line Maintenance

Inspection of the entire transmission line system will be conducted semi-annually. Aerial inspection will be conducted by helicopter semi-annually and will require two or three crew members, including the pilot. Detailed ground inspections will take place on an annual basis. Ground inspection would use 4x4 trucks or 4x4 ATVs for all structures with access roads. For structures in areas without permanent access roads, ground inspection will be on foot or by other approved means. The inspector would assess the condition of the transmission line and hardware to determine if any components need to be repaired or replaced, or if other conditions exist that require maintenance or modification activities. The inspector would also note any unauthorized encroachments and trash dumping on the ROW that could constitute a safety hazard. The inspector would access each of the structure locations along each line and use binoculars and spotting scopes to perform this inspection.

If during transmission line maintenance and monitoring, it is determined that new or reconstruction activities should be implemented, the Applicant will notify the appropriate land management agency or private landowner.

Dust control during maintenance of the transmission line will be managed the same as during construction.

6.3.1 Routine Maintenance and Repairs

Routine maintenance activities are ordinary maintenance tasks that have historically been performed and are regularly carried out on a routine basis. The work performed is typically repair or replacement of individual components (no new ground disturbance), performed by relatively small crews using a minimum of equipment, and usually is conducted within a period from a few hours up to a few days. Work requires access to the damaged portion of the line to allow for a safe and efficient repair of the facility. Equipment required for this work may include four-wheel-drive trucks, material (flatbed) trucks, bucket trucks (low reach), boom trucks (high reach), or man lifts. This work is typically required due to issues found during inspections. For maintenance work near energized parts (insulators, hardware, conductors) and to the extent practicable, this work is scheduled for times when the transmission line can be taken out of service and de-energized. Typical items that may require periodic replacement on structures include insulators, hardware, or structural members. It is expected that these replacements would be required infrequently.

The Applicant plans to conduct maintenance on the ±600 kV DC, 500 kV AC and 230 kV AC transmission lines whenever practical in a de-energized condition. However, provisions for the use of live line maintenance techniques have been planned into the Project. Maintenance on the transmission lines can be completed safely using live line techniques thereby avoiding an outage to the critical transmission line infrastructure. High reach bucket trucks along with other equipment are used to conduct both de-energized and live-line maintenance activities. For the ±600 kV DC, 500 kV AC and 230 kV AC structures, this requires that adequate space be available at each structure site so that the high reach bucket truck can be positioned to one side or the other of the structure and reach up to or

over the poles/phases to access the poles/phases or upper sets of wires (shield wires or OPGW) to perform the live-line maintenance procedures. To allow room at each structure for these activities in low slope areas a crane pad is required with the structure in the center of 250 feet (ROW width) by 100 feet for the ±600 kV DC and 500 kV structures and 125 feet by 50 feet for the 230 kV structures. The size and location of these required crane pads near the structures may vary depending on the side slope and access road at each site. The pads are cleared to the extent needed to safely complete the work. The Applicant will work with the BLM Field Offices and USFS on a case-by-case basis to determine what size pad would be left in place and revegetated following initial construction for operations and maintenance.

For all structures in locations without permanent ground access, maintenance activities will be performed using low impact ground-based equipment and/or by helicopter/aerial methods. Maintenance activities for structures in these locations (without permanent ground access) will be performed using the same or similar equipment and methods as was used for initial construction.

6.3.2 ROW Maintenance and Repairs

The Applicant will maintain work areas adjacent to structures and along the ROW for vehicle and equipment access necessary for operations, maintenance, and repair. Where long-term access is required for maintenance of the line, the Applicant will maintain the approved access roads in a safe, useable condition, as directed by an authorized officer from the appropriate land management agency or private landowner.

When needed, ROW repairs may include grading or repair of existing maintenance access roads and work areas, and spot repair of sites subject to erosion, flooding or scouring. Access road maintenance entails activities to ensure that approved access roads are in appropriate condition for access to transmission lines by maintenance and inspection crews. These activities include re-grading, re-surfacing, and re-constructing water diversions such as culverts, ditches and water bars. Required equipment may include a grader, backhoe, four-wheel-drive pickup truck, and a cat-loader or bulldozer. The cat-loader has steel tracks whereas the grader, backhoe, and truck typically have rubber tires. Repairs to the ROW would be scheduled as a result of line inspections, or would occur in response to an emergency situation.

Snow removal, if necessary for terminal, substation, ground electrode and regeneration station access roads, will be performed with blades equipped with shoes to keep the blade off the road surface in order to avoid damage.

Vegetation within the ROWs will be managed in accordance with the TWE Project Vegetation Management Program described below in Section 6.3.4.

6.3.3 Access Road Maintenance

Authorized access roads will only be used for maintenance purposes upon completion of construction. Where long-term access is required for maintenance of the line, the Applicant shall maintain the approved access roads in a safe, useable condition, as directed by an authorized officer from the appropriate land management agency. A regular maintenance program may include, but is not limited to blading, ditching, culvert installation, and surfacing.

If snow removal is necessary, equipment used shall be equipped with shoes to keep the blade two inches off the road surface in order to avoid damage to it. Where the ground is uneven at drainage crossings, special precautions will be taken in order to ensure equipment blades do not destroy vegetation.

6.3.4 Vegetation Management

A framework ROW Preparation and Vegetation Management Plan is provided in Appendix R. This plan will be further developed for the selected Alternative in the ROD POD. The Plan will be designed to meet NERC reliability requirements in a cost-effective manner, and provide measures for minimizing potential conflicts with critical environmental resources or management issues. Vegetation management in the TWE Project transmission line ROWs will be based on meeting reliability requirements of NERC through integrative vegetation management (IVM) practices (NERC 2009; ANSI 2006). The TWE Project will comply with NERC reliability standards.

NERC has established reliability standard FAC-003-2 to prevent vegetation related outages from occurring on bulk transmission systems, which could lead to cascading outages. The standard was developed in response to serious outages and operational problems, which have resulted from interference between overgrown vegetation and transmission lines over the past 10 to 20 years. Compliance with this standard is mandatory. FAC-003-2 requires having and implementing a documented transmission vegetation management program, designed to control vegetation on transmission ROWs (NERC 2009).

IVM is a best management practice conveyed in the American National Standard for Tree Care Operations, Part 7 (ANSI 2006) and the International Society of Arboriculture's *Best Management Practices: Integrated Vegetation Management* (Miller 2007). IVM is consistent with the requirements of FAC-003-2 and is recognized as containing the most appropriate techniques for transmission ROWs to meet and exceed the NERC requirements (NERC 2009). IVM is a system of managing plant communities by setting objectives for desired conditions and identifying and managing ROWs for compatible and incompatible vegetation. Implementation of TWE Project's ROW Preparation Vegetation Management Plan (Appendix R) will comply with NERC standards through IVM practices. IVM principles will serve as guidance in establishing and maintaining a desired condition for TWE Project ROWs and associated facilities.

6.4 Terminals, Substation, Ground Electrode and Communication Systems Maintenance

Maintenance activities include equipment testing, equipment monitoring and repair, and emergency and routine procedures for service continuity and preventive maintenance. Terminal, substation, ground electrode, and regeneration station monitoring and control functions are performed wholly or in part remotely from the Applicant's central operations facilities. Unauthorized entry into the terminal, substations or regeneration stations is prevented with the provision of fencing and locked gates. Warning signs would be posted and entry to the operating facilities would be restricted to authorized personnel.

Several forms of security are planned for each of the locations, although the security arrangements at each of the terminals, substations, ground electrode facilities, or regeneration stations may differ somewhat. Security measures may include fire detection in the control building via a monitoring system; alarming for forced entry; and a perimeter security system coupled with remote sensing infrared camera equipment in the fenced area of the station to provide visual observation/confirmation to the system operator of disturbances at the fence line.

Safety and security lighting at the terminals, substations and series compensation stations would be provided inside the fence for safety and security and for uncommon emergency night repair work. Dusk to dawn safety and security lighting will be used at the terminals and 500 kV AC substations.

Each of the terminals may have a control room staffed 24 hours per day, 365 days per year by two to three system operators and supervisory personnel. Remote operation, typically from control rooms housed in nearby utility facilities, may be utilized. In addition to control room staffing, 8 to 20 technicians, engineers, maintenance, security, and supervisory personnel may be staffed at each terminal. Total staffing at each terminal is expected to be 20 to 30 people.

Routine maintenance for the terminal and adjacent substations would be performed by the on-site staff. Major inspection or maintenance activities would require additional personnel and equipment estimated to be 15 to 20 craft, technician, engineering, manufacturer, consultant and supervisory personnel for a period of two to four weeks on an estimated once per year basis.

For AC substations and series compensation stations located remote from the terminals it is anticipated that maintenance at each of these remote facilities would require approximately six trips per year by a two to four person crew. Routine operations would require two workers in a light utility truck to visit the remote substation or series compensation station monthly. Typically, once per year a major inspection or maintenance effort may be required which would require up to 15 personnel for one to three weeks. If substation landscaping is required by the permitting agency, drought-tolerant plant materials would be used to minimize watering requirements after plant establishment.

Ground electrode facilities would be visited every two to three months by two individuals in a light truck to inspect the facilities. Annual maintenance would be performed by a two man crew in a light truck over a two to five day period. The ground electrode connector line would be inspected by aerial and ground based inspection identical to the maintenance program described for the transmission lines.

Communication regeneration stations would be visited every two to three months by two individuals in a light truck to inspect the facilities. Annual maintenance would be performed by a two-man crew in a light truck over a two to five day period.

Water Use

Operation and maintenance of the Northern and Southern Terminals is expected to require water use by personnel in the Operations and Maintenance office building and by the HVDC evaporative cooling and misting systems during summer months. Monthly and annual estimated water use is provided in Table 12.

TABLE 12 NORTHERN AND SOUTHERN TERMINAL ANNUAL ESTIMATED WATER USE (ALL VALUES IN ACRE-FEET)

MONTH	OFFICE USE	COOLING & MISTING SYSTEMS FOR N. TERMINAL	COOLING & MISTING SYSTEMS FOR S. TERMINAL	TOTAL USE N. TERMINAL	TOTAL USE S. TERMINAL
January	0.07	0	0	0.07	0.07
February	0.06	0	0	0.06	0.06
March	0.07	0	0	0.07	0.07
April	0.07	0	0	0.07	0.07
May	0.07	0	0.03	0.07	0.10
June	0.07	0.07	0.07	0.13	0.13
July	0.07	0.14	0.14	0.21	0.21
August	0.07	0.07	0.14	0.14	0.20
September	0.07	0	0.07	0.07	0.13
October	0.07	0	0	0.07	0.07
November	0.07	0	0	0.07	0.07

MONTH	OFFICE USE	COOLING & MISTING SYSTEMS FOR N. TERMINAL	COOLING & MISTING SYSTEMS FOR S. TERMINAL	TOTAL USE N. TERMINAL	TOTAL USE S. TERMINAL
December	0.07	0	0	0.07	0.07
Annual	0.81	0.27	0.44	1.08	1.25

Source: BBA 2012

Annual office use of water for each terminal is estimated at 0.809 acre-feet. The office building will consist of approximately 7,200 square feet of actively used space including offices, kitchen, and bathrooms with a shower. The annual office water use was conservatively estimated based upon this actively used square footage and a water use estimate of 0.75 acre-feet per year per 6,695 square feet of office space (Douglas County 1999).

Evaporative cooling will not likely be needed for ambient air temperatures up to 104° Fahrenheit (40° Celsius). If ambient air temperatures exceed 113° Fahrenheit (45° Celsius), then misting and evaporative cooling will be required for these short time periods.

Annual water use for HVDC evaporative cooling and misting systems at the Northern Terminal is estimated at 0.272 acre-feet. Use includes 400 gallons per year for maintenance and flushing of the cooling system and an estimated 88,000 gallons per year for the misting system. The misting system use was estimated to at 275 gallons per hour, running eight hours per day for 10 days in June, 20 days in July, and 10 days in August for a total of 40 days. Evaporative cooling of the filters is not anticipated.

Annual water use for HVDC evaporative cooling and misting systems at the Southern Terminal is estimated at 0.440 acre-feet. Use includes 400 gallons per year for maintenance and flushing of the cooling system and an estimated 143,000 gallons per year for the misting system. The misting system use was estimated to at 275 gallons per hour, running eight hours per day for 5 days in May, 10 days in June, 20 days in July, 20 days in August and 10 days in September for a total of 65 days. Evaporative cooling of the filters is not anticipated.

The water use for each of the terminals may vary from these estimates based on the cooling system technology employed for the terminals. Non-evaporative cooling technologies are available and will be considered during the detailed engineering for the terminal equipment.

6.5 Emergency Response

The operation of the system is managed and monitored from control rooms at or near each of the terminals and at the Applicant's operation center. Electrical outages or variations from normal operating protocols would be sensed and reported at these operation centers. The remote substations and series compensation stations are equipped with remote monitoring, proximity alarms, and in some cases, video surveillance with monitoring and control functions performed at the control rooms at the terminals and/or at the Applicant's operation center.

The implementation of routine operation and maintenance activities on power lines minimize the need for most emergency repairs. Emergency maintenance activities are often those activities necessary to repair natural hazard, fire, or human-caused damages to a line. Such work is required to eliminate a safety hazard, prevent imminent damage to the power line, or restore service if there is an outage. In an emergency, the Applicant must respond as quickly as possible to restore power.

In most cases, the equipment necessary to carry out emergency repairs is similar to that necessary to conduct routine maintenance. More extensive emergency repair may also require the same types of equipment used during construction, including hole drilling equipment, backhoes for excavation, and/or concrete trucks and cranes for structure erection. Other required equipment may include power tensioners, pullers, wire trailers, crawler tractors, and trucks and pickups for hauling materials, tools, and workers. Under certain conditions, a helicopter may be used to haul in material and erect towers or string conductor in those areas where access and/or terrain conditions preclude the use of conventional methods. Site and access road disturbances, such as ruts created during emergency operations, will be restored to satisfactory condition using restoration and rehabilitation procedures.

In the event of an emergency, crews will be dispatched quickly to repair or replace any damaged equipment. Every attempt will be made to contact the agency or landowners along the ROW. In the event notification cannot be made, repair operations will proceed only in the case of an emergency situation. Repair of the line will have priority under emergency conditions, and reasonable efforts will be made to protect plants, wildlife, and other resources. Restoration and rehabilitation procedures following completion of repair work will be similar to those prescribed during construction.

Emergency response procedures will be implemented for the following potential events:

- Downed transmission lines, structures, or equipment failure
- Fires
- Sudden loss of power
- Natural disasters
- Serious personal injury

A detailed Emergency Preparedness and Response Plan is provided in Appendix F.

6.5.1 Fire Protection

All federal, state, and county laws, ordinances, restrictions, rules, and regulations pertaining to fire prevention and suppression would be strictly adhered to. All personnel would be advised of their responsibilities under the applicable fire laws and regulations. A framework Fire Protection Plan is provided in Appendix H.

When working on public or National Forest System lands, the Applicant's employees and Contractors would be equipped with approved suppression tools and equipment. The Applicant or its Contractor would notify local fire authorities and the BLM or USFS (as appropriate) if a Project-related fire occurs within or adjacent to a construction area.

If the Applicant becomes aware of an emergency situation that is caused by a fire on or threatening BLM-managed or USFS lands and that could damage the transmission lines or their operation, it would notify the appropriate agency contact. Specific construction-related activities and safety measures would be implemented during construction of the transmission line to prevent fires and to ensure quick response and suppression if a fire occurs. Typical practices to prevent fires during construction and maintenance/repair activities include brush-clearing prior to work, stationing a water truck at the job site to keep the ground and vegetation moist in extreme fire conditions, enforcing red flag warnings, providing "fire behavior" training to all pertinent personnel, keeping vehicles on or within designated roads or work areas, and providing fire suppression equipment and emergency

notification numbers at each construction site. A detailed Fire Protection Plan is included as Appendix H.

6.6 Decommissioning Practices

The proposed transmission line would have a projected operational life of at least 50 years or longer. At the end of the useful life of the Project and if the facility were no longer required, the transmission line would be removed from service. At such time, structures, conductors, insulators, and hardware would be dismantled and removed from the ROW. The transmission foundations would be removed to below-ground surface.

Following abandonment and removal of the transmission line structures and equipment from the ROW, any areas disturbed during line dismantling would be restored and rehabilitated. In the same way, if a terminal, substation, or regeneration station is no longer required, the buildings, structures and equipment would be dismantled and removed from the site. The station structures would be disassembled and either re-used at another station or sold for scrap. Major equipment such as breakers, transformers, and reactors would be removed, refurbished, and stored for use at another facility. Foundations would be cut off below ground surface.

For access roads constructed by the Applicant and used for operations and maintenance of the transmission line, the Applicant will reclaim all access roads unless the landowner, land management agency, or county requests the road to remain open and the landowner, land management agency or county agrees in writing to assume all maintenance and reclamation responsibility for the road.

7.0 DESIGN OPTIONS

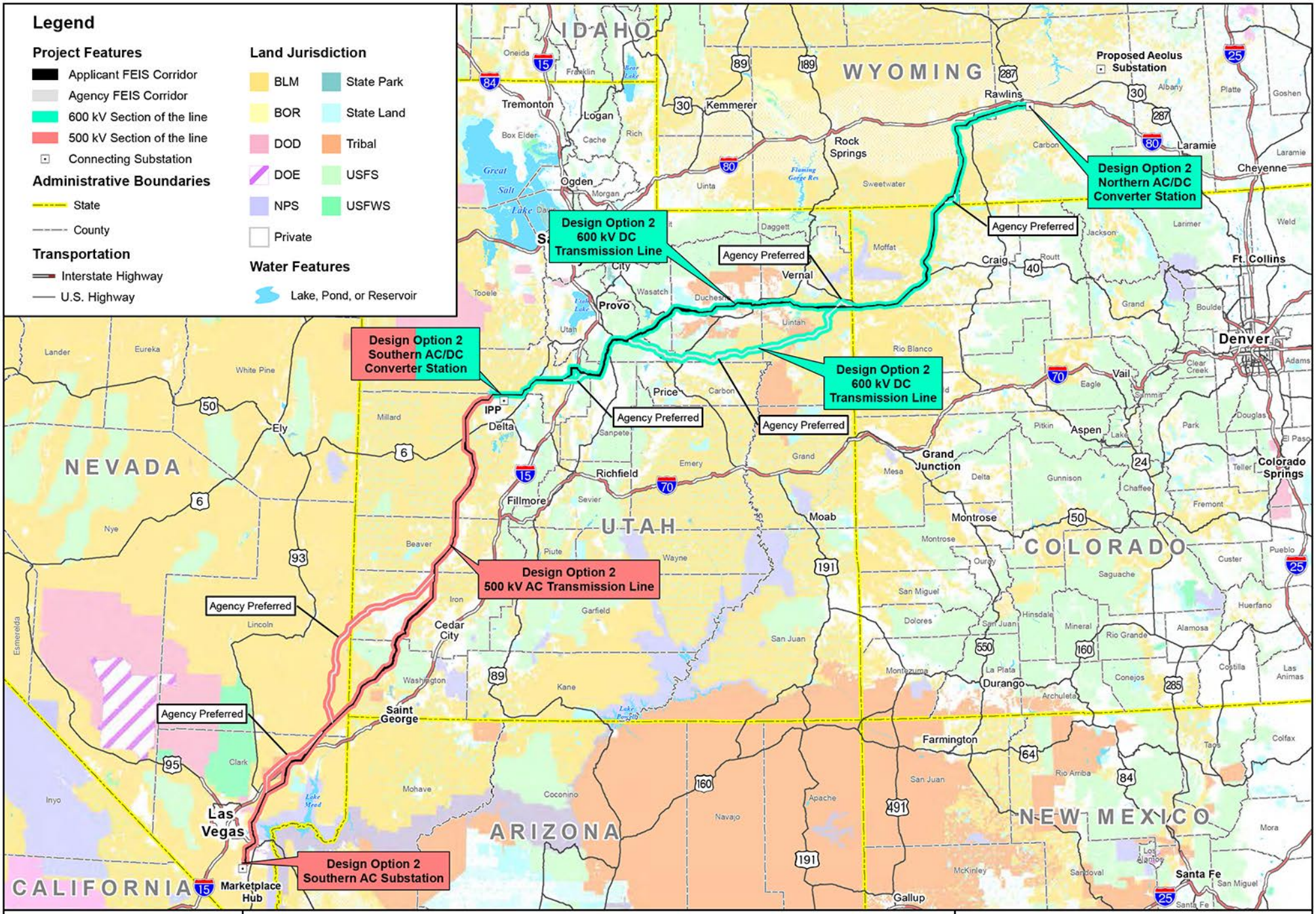
Section 7.0 describes the Design Options, formerly referred to as System Alternatives, considered for the TWE Project. System Alternatives 1, 2 and 3, were initially suggested by TransWest in the *TransWest Express Transmission Project ROW Application SF 299 (Amended from December 2008) January 2010* (TWE 2010b). TransWest amended the Preliminary ROW Application SF 299 to eliminate System Alternative 1 from further consideration in August 2012. System Alternatives 2 and 3 are recommended by TransWest for inclusion in the FEIS and from here on are referred to as Design Options 2 and 3.

- Section 7.1 provides an overview of Design Options 2 and 3.
- Section 7.2 describes the design options according to the conditions under which each design option would meet the TWE Project purpose and need and the options' specific components and design characteristics.
- Section 7.3 discusses how the design options would differ from the proposed TWE Project with respect to construction, operation, and maintenance practices.
- Section 7.4 provides a comparison of the design options to the proposed TWE Project.

7.1 Overview of Design Options

Design Option 2 – Design Option 2 would be an alternative system configuration, which would replace the proposed TWE Project (Map Exhibit 6). This alternative would entail TransWest constructing and operating a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length, from the Northern Terminal to a new AC/DC converter station near the existing IPP Substation near Delta, Utah. From the new AC/DC converter station in Utah, a single circuit 1,500 MW, 500 kV AC transmission line, approximately 350 miles in length, would be constructed to one of the existing substations in the Eldorado Valley, south of Boulder City, Nevada (Marketplace Hub). Near the halfway point of the southern segment (AC segment), a 500 kV Series Compensation Station would also be constructed.

Design Option 3 – Design Option 3 would be a phased approach to building and operating the proposed TWE Project (Map Exhibit 7). This phased approach would entail construction of a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length between the location of the proposed Northern Terminal to the IPP substation near Delta, Utah and operated initially as a 1,500 MW, 500 kV AC transmission system. For AC operation, the initial phase of this design option would require 500/345 kV substation connections near the IPP line in Millard County, Utah and construction of a 500 kV series compensation station near the halfway point of the northern segment. Full development of the TWE Project using this phased build out approach would involve constructing the remaining portion of the 3,000 MW, ±600 kV DC line from IPP to the Southern Terminal, south of Boulder City, Nevada and converting operations to a DC system.



Map Exhibit 6

Design Option 2: DC from Wyoming to IPP, AC from IPP to Marketplace Hub

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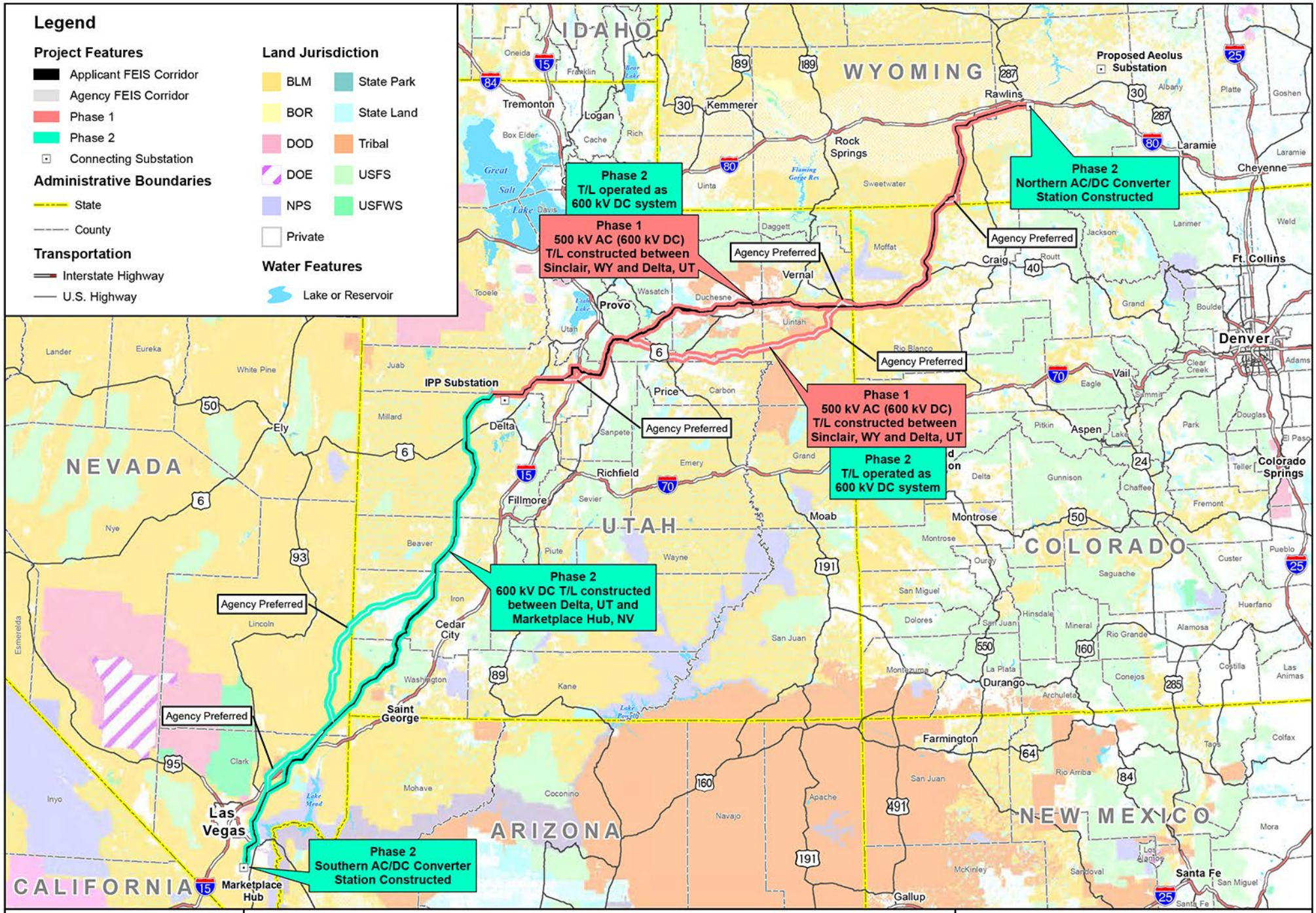

Map Exhibit 7
Design Option 3: Phased Build-Out
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7.2 Design Options' Purpose and Need and Design Characteristics

7.2.1 Design Option 2 – DC from Wyoming to IPP, AC from IPP to Marketplace Hub

Design Option 2 would meet the TWE Project's stated objectives only if transmission capacity becomes available and can be utilized to transmit energy delivered by the TWE Project from Delta, Utah to Southern California. Under this design option, the delivery of energy to markets in the Desert Southwest region would be through both the new 1,500 MW, 500 kV transmission line and through the existing 2,400 MW, 500 kV DC transmission system, IPP's 'Southern Transmission System' (STS), between Delta, Utah and Adelanto, California. Because capacity is not currently available on the STS, Design Option 2 does not currently meet the TWE Project's purpose and need. Should capacity become available in the future, TransWest would only consider implementing this design option under the conditions that sufficient capacity, approximately 1,500 MW, was commercially available to transmit energy delivered by the TWE Project to California; and that TransWest is able to establish commercial interconnection agreements with the utility owning and operating the IPP transmission line (currently Los Angeles Department of Water and Power [LADWP]). TransWest will provide the lead agencies with notice if a decision is made to implement Design Option 2.

Design Option 2 would replace the proposed TWE Project. This alternative would entail a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length, from the Northern Terminal to a new AC/DC converter station near the existing IPP substation near Delta, Utah. From the new AC/DC converter station in Utah, a single circuit 1,500 MW, 500 kV AC transmission line, approximately 350 miles in length, would be constructed to one of the existing substations in the Eldorado Valley, south of Boulder City, Nevada (Marketplace Hub). See Map Exhibit 6.

Design Option 2 would entail the following specific facilities and actions:

1. Construction of the Northern Terminal and ground electrode system (identical facilities to the proposed TWE Project);

2. Construction of a new AC/DC converter station and an adjacent 500/345 kV AC substation near the IPP in Millard County, Utah;

3. Construction of a ground electrode system within 50 miles of Delta, Utah;

4. Construction of a double circuit 345 kV AC line between the new 500/345 kV AC Substation near IPP to the existing IPP 345 kV AC substation adjacent to the existing IPP AC/DC converter station. The length of the double circuit 345 kV AC connection is estimated to be less than five miles;

5. Construction of a ±600 kV DC transmission line, approximately 375 miles long, from the Northern Terminal to the new AC/DC converter station and associated 500/345 kV substation near IPP (northern segment, similar to proposed TWE Project);

6. Construction of a single circuit, 1,500 MW, 500 kV AC line from the new 500/345 kV AC substation near IPP to one of the existing Marketplace Hub substations in the Eldorado Valley (southern segment); and

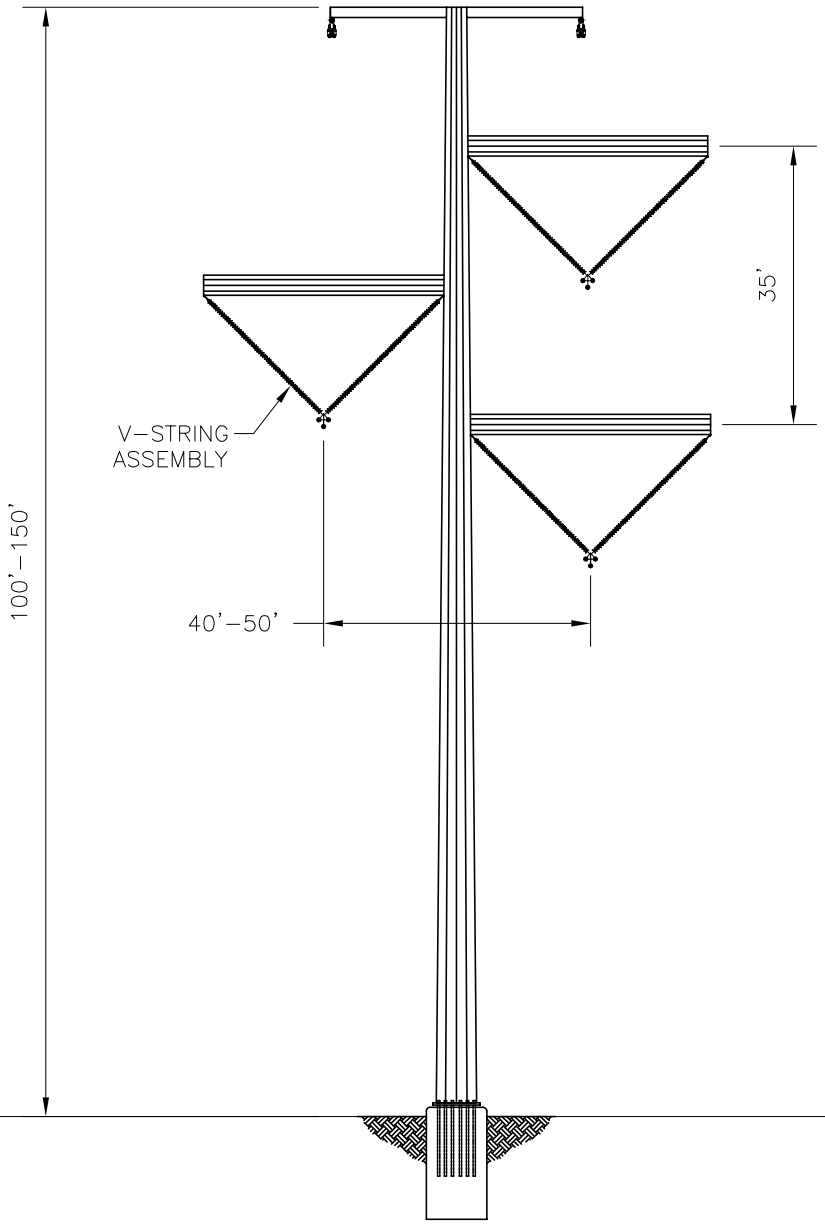
7. Construction of a series compensation station (similar to a small 500 kV substation) adjacent to the 500 kV AC transmission line, near the halfway point in the 500 kV AC line southern segment.

Compared to the proposed TWE Project, Design Option 2 would: 1) replace the ±600 kV DC transmission line with a single circuit 500 kV AC line, from near IPP in Millard County, Utah to one of the existing Marketplace Hub substations in Clark County, Nevada; 2) eliminate the Southern Terminal and ground electrode system in Clark County, Nevada and replace these facilities with similar facilities near IPP in Millard County, Utah; 3) construct additional new facilities, including a 500/345 kV AC substation, a double circuit 345 kV transmission line, less than five miles in length, and a 500 kV series compensation station, near the halfway point in the 500 kV AC line.

Design Option 2 would require both a 500 kV single circuit AC configuration and a 345 kV double circuit AC configuration. Design Option 2 would require a single circuit 500 kV configuration and structures, similar to the structure design shown in Figures 21 and 22. The 500 kV single circuit configuration would require three sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 500 kV structures including foundations, guys, anchors, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

One double circuit 345 kV transmission line would be required for Design Options 2 and 3. The 345 kV double circuit structures would be either self-supporting steel lattice towers or single shaft tubular steel poles. Figure 22 shows a typical steel pole design. The 345 kV double circuit configuration would require six sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 345 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

Map Exhibit 8 depicts the siting areas for the Design Option 2 AC/DC converter station, 500/345 kV AC substation, ground electrode system, double circuit 345 kV connector line and the 500 kV series compensation station. The substation would be located on one of the two parcels shown on the map.



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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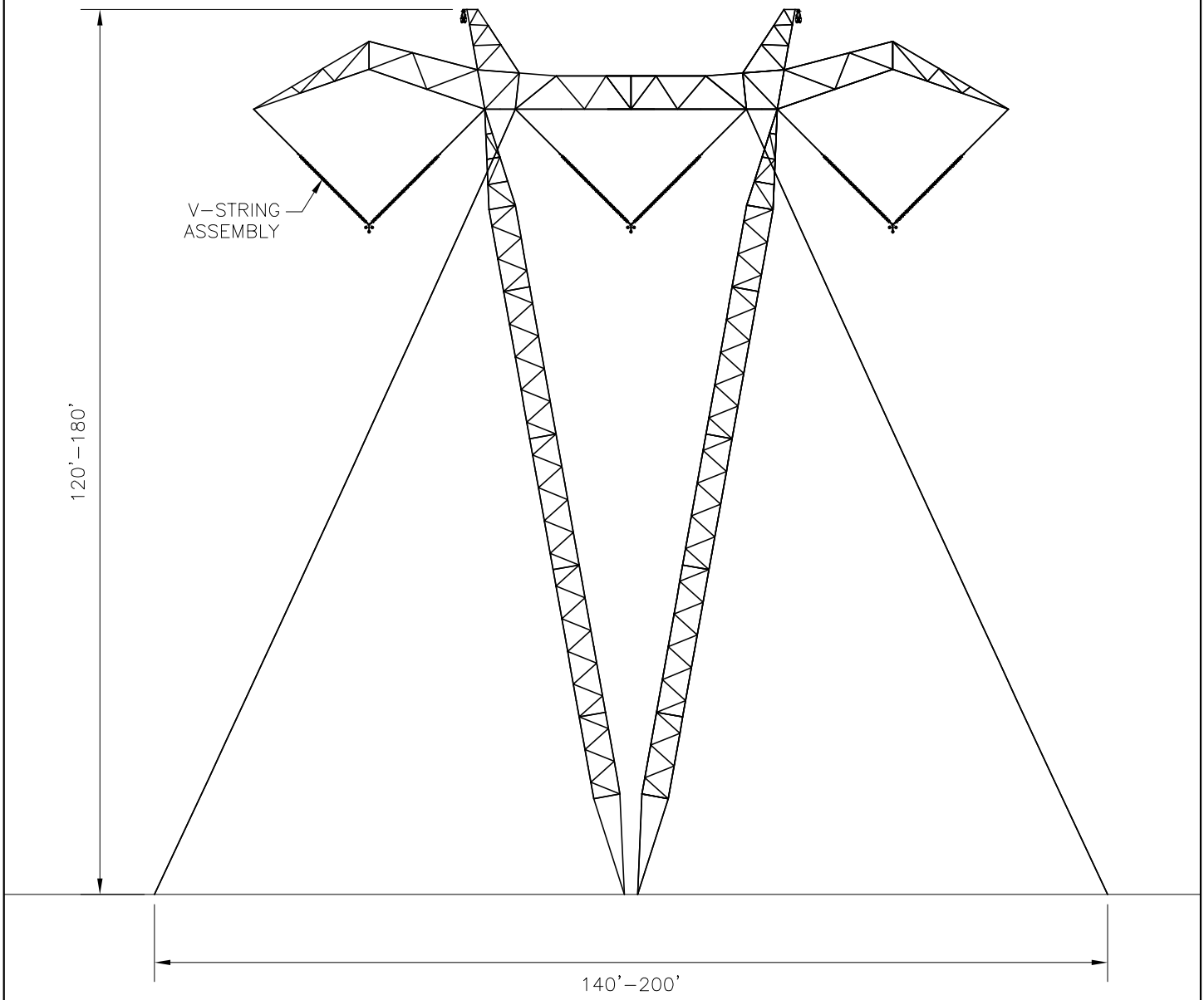
FIGURE 23

TYPICAL 500kV AC SINGLE CIRCUIT
TUBULAR POLE STRUCTURE



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.
2. TOWER OUTLINE AND BRACINGS ARE INDICATIVE ONLY.

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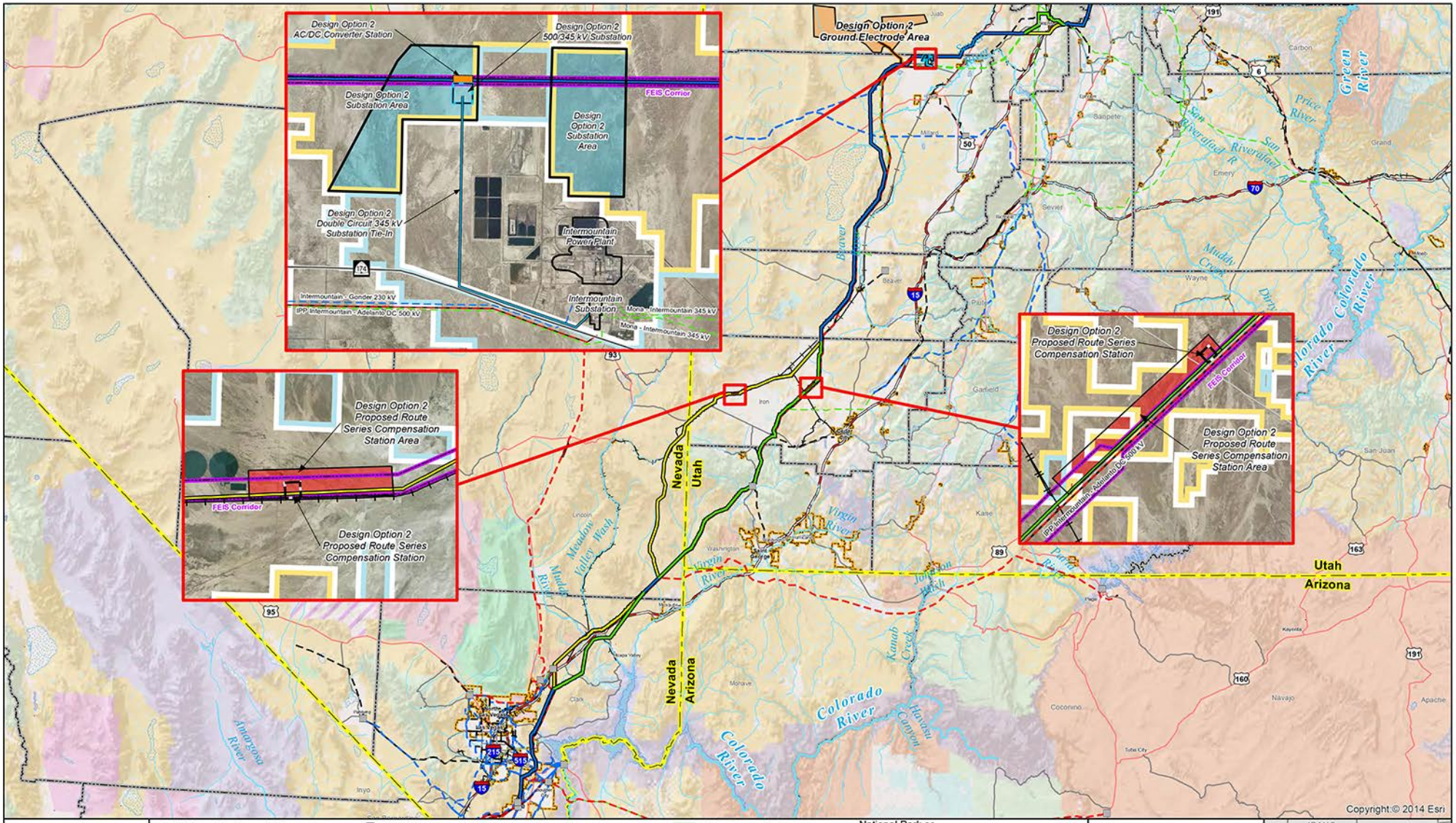
FIGURE 24

TYPICAL 500kV AC
SINGLE CIRCUIT GUYED
LATTICE STRUCTURE



TransWest Express Transmission Project
May 2014

Map Exhibit 8

Design Option 2 Components

Preliminary Engineered Alignments
- Applicant Proposed
- Agency Preferred
- Applicant/Agency Preferred

Project Features
- FEIS Corridor
- Terminal Siting Area
- Ground Electrode Area
- Ground Electrode Site
- 34.5 kV Electrode Line

Administrative Boundaries
- Municipal Boundary

Existing Transmission
- 500 kV Line
- 500 kV DC Line
- 345 kV Line
- 287 kV Line
- 230 kV Line
- 138 kV Line
- Substation

Land Jurisdiction
- Indian Reservation
- State Land
- USDA Forest Service
- State Park or Recreation Area
- U.S. Department of Energy
- U.S.Department of Defense
- National Park or National Monument
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service

0 10 20 30 40 Miles

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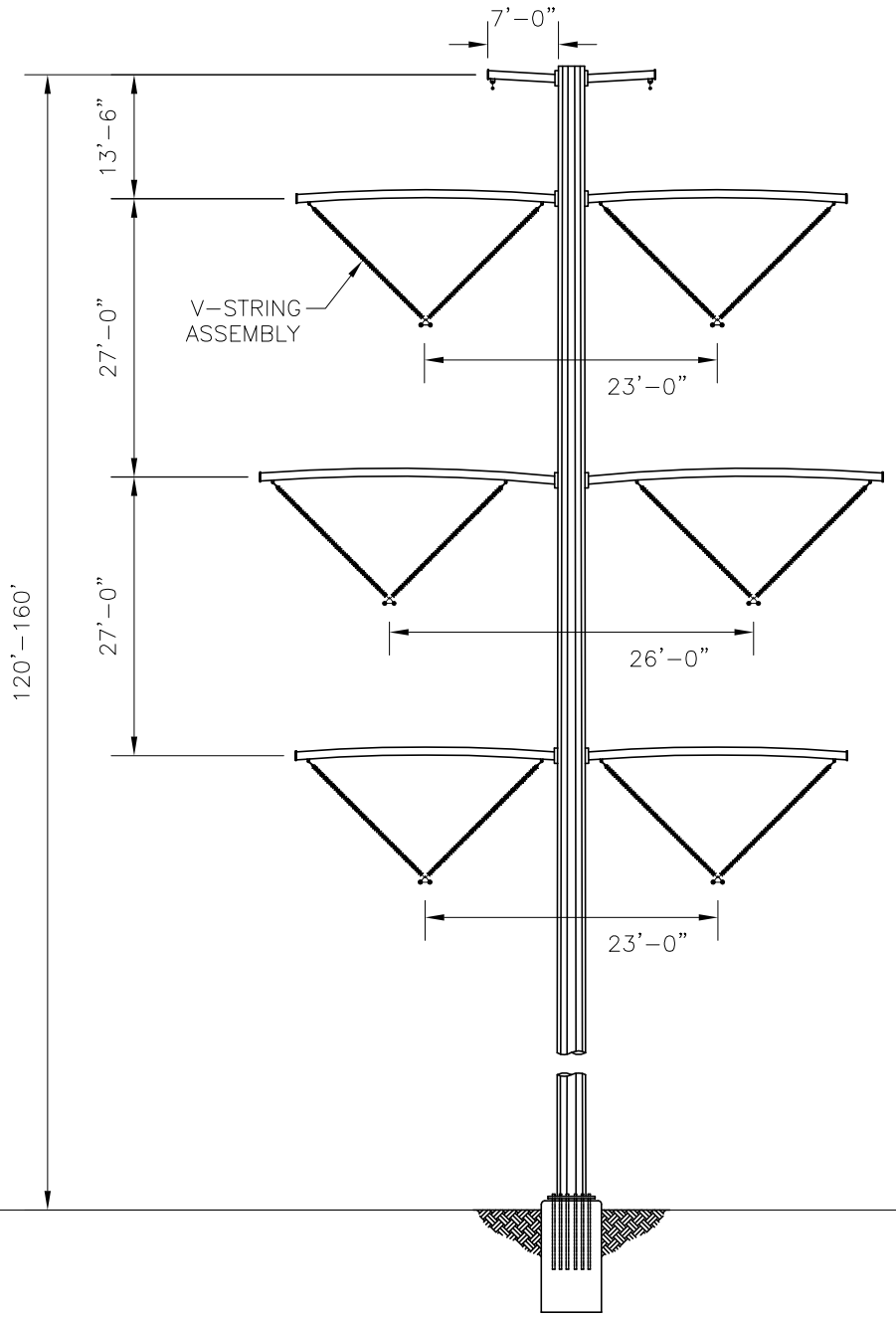

NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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FIGURE 25

TYPICAL 345kV AC DOUBLE CIRCUIT
SELF SUPPORTING STEEL POLE STRUCTURE

7.2.2 Design Option 3 – Phased Build Out

Similar to Design Option 2, this Design Option would meet the TWE Project's stated objectives only if transmission capacity becomes available and can be utilized to transmit energy delivered by the TWE Project from Delta, Utah to Southern California. This initial delivery of energy to markets in the Desert Southwest region would be through the existing 2,400 MW, 500 kV DC transmission system, and IPP's STS. This design option would meet the TWE Project's objectives and is considered feasible, however, it is more costly than building out the full system as a single non-phased project and would only be required if the demand for Wyoming resources in the Desert Southwest proves to be slower in development than expected. Construction of the line between Utah and Nevada, the Southern Terminal and completion of the Northern Terminal would be phased, however, to occur at some point in the future when market demands warrant converting the line's operation from 1,500 MW to 3,000 MW.

Should capacity become available, TransWest would only consider implementing this design option under the condition that sufficient capacity, approximately 1,500 MW, was commercially available to transmit energy delivered by the TWE Project to California; and that TransWest is able to establish commercial interconnection agreements with the utility owning and operating the IPP transmission line (currently LADWP). A market analysis would also need to be completed with results showing a phased approach to be commercially beneficial. TransWest will provide the lead agencies with notice if a decision is made to implement Design Option 3.

Design Option 3 is similar to the proposed TWE Project, except the project would be built and operated in phases. This phased approach would entail construction of a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length between the location of the proposed Northern Terminal to the IPP substation near Delta, Utah and operated initially as a 1,500 MW, 500 kV AC transmission system. For AC operation, the initial phase of this design option would require 500/345 kV substation connections near the IPP in Millard County, Utah and construction of a 500 kV Series Compensation Station near the halfway point of the northern segment. Full development of the TWE Project using this phased build out approach would involve constructing the remaining portion of the 3,000 MW, ±600 kV DC line from IPP to the Southern Terminal, south of Boulder City, Nevada and converting operations to a DC system (see Map Exhibit 7).

The TWE Project would be energized in phases. Phase 1 would entail the following:

1. Construction of the 500 kV substation portion of the Northern Terminal. The adjacent AC/DC converter station in Wyoming would be built in Phase 2;

2. Construction of a 500/345 kV AC substation in the vicinity of the existing IPP 345 kV substation near Delta, Utah;

3. Construction of a single circuit 500 kV AC line from the Northern Terminal near Sinclair, Wyoming to the new 500/345 kV AC substation near IPP (northern line segment). The single circuit 500 kV AC line would be designed to operate at both 500 kV AC and ±600 kV DC for easy conversion to ±600 kV DC operation;

4. Construction of a 500 kV series compensation station near the halfway point of the 500 kV AC northern line segment;

5. Construction of a double circuit 345 kV transmission line connecting the new 500/345 kV AC substation to the existing IPP 345 kV substation. The length of the double circuit 345 kV AC connection is estimated to be less than five miles; and

6. Energization of Phase 1 of Design Option 3 as a 1,500 MW, 500 kV AC system.

Phase 2 would entail the following:

1. Construction of the AC/DC converter station portion of the Northern Terminal in Wyoming and construction of the entire Southern Terminal in Nevada;

2. Construction of the ground electrodes for both the Northern and Southern Terminals (see Map Exhibits 4 and 5);

3. Construction of the ±600 kV DC transmission line between IPP and the Southern Terminal (southern line segment);

4. Removal of the connection to the IPP substation at Delta, Utah and connecting the Phase 1 500 kV AC line (constructed during Phase 1, designed for conversion to ±600 kV DC and operated at 500 kV AC during Phase 1) to the Phase 2 ±600 kV DC line between Delta, Utah and the Southern Terminal;

5. Convert the operation of the TWE Project to a 3,000 MW, ±600 kV DC system;

6. Decommission the 500/345 kV AC substation at IPP;

7. Decommission the double circuit 345 kV transmission line at IPP; and

8. Decommission the series compensation station on the 500 kV AC northern line segment.

Design Option 3 would utilize the same transmission corridor as the proposed TWE Project. Construction of the Northern Terminal in Wyoming would occur in phases. Phase 1 would require the construction of the AC substation portion of the Northern Terminal complex. In Phase 2, the AC/DC converter station portion of the Northern Terminal complex would be constructed adjacent to the 500 kV AC substation constructed in Phase 1, completing the Northern Terminal. The AC operation of the northern line segment would require the construction of a 500/345 kV substation near IPP. Upon conversion of the line to DC operations, this 500/345 kV substation would be decommissioned along with the double circuit 345 kV line. The 500 kV AC line constructed in Phase 1 from Wyoming to Utah (northern line segment) would be designed and constructed as a DC line to a criteria that would enable it to be initially operated at 500 kV AC and then converted from 500 kV AC operation to ±600 kV DC operation. No further changes to the transmission line would be required to convert the line from AC to DC operation. AC operation of the northern line segment would require the construction of a 500 kV series compensation station near the halfway point of this segment. Upon conversion of the line to DC operations, this 500 kV series compensation station would be decommissioned.

Phase 1 of Design Option 3 would require a single circuit 500 kV AC configuration designed and constructed to meet the ±600 kV DC criteria. The typical Phase 1 single circuit 500 kV AC structures would be similar in appearance to those shown in Figures 21 and 22. The single circuit 500 kV AC configuration would require three sets of conductor bundles, one steel shield wire, and one OPGW. The conversion from 500 kV AC to ±600 kV DC would not require physical changes to the structure

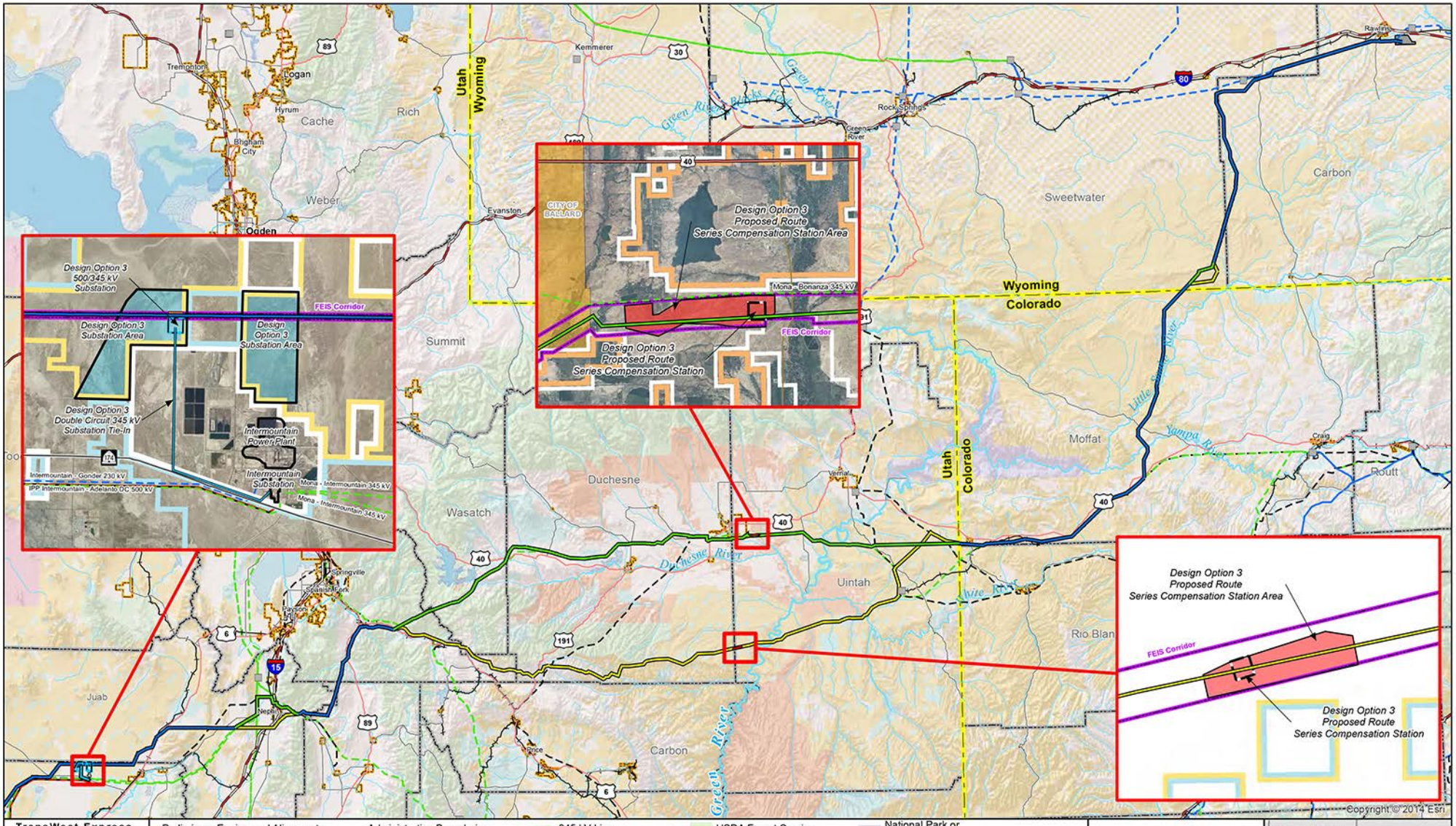
or wire system constructed in Phase 1 as one of the three conductor bundle sets would be de-energized and left in place.

Phase 1 of Design Option 3 would also require one 345 kV double circuit transmission line. The 345 kV double circuit structures would be either self-supporting steel lattice towers or single shaft tubular steel poles. Figure 22 shows a typical steel pole design. The 345 kV double circuit configurations would require six sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 345 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

Map Exhibit 9 depicts the siting areas for the Design Option 3 components, including the 500/345 kV AC substation, double circuit 345 kV connector lines and the 500 kV series compensation station.

7.3 Construction, Operation and Maintenance Activities of Design Options

The construction, operation, and maintenance activities described for the proposed TWE Project would be very similar for most aspects of the design options. Applicant-committed environmental mitigation measures would also apply to these alternatives. This section discusses key differences between the design options and the proposed TWE Project.



TransWest Express Transmission Project
May 2014

Map Exhibit 9

Design Option 3 Components

Preliminary Engineered Alignments
- Applicant Proposed
- Agency Preferred
- Applicant/Agency Preferred

Project Features
- FEIS Corridor
- Terminal Siting Area

Administrative Boundaries
- Municipal Boundary

Existing Transmission
- 500 kV Line
- 500 kV DC Line
- 345 kV Line
- 287 kV Line
- 230 kV Line
- 138 kV Line
- Substation

Land Jurisdiction
- Indian Reservation
- State Land
- USDA Forest Service
- State Park or Recreation Area
- U.S. Department of Energy
- U.S.Department of Defense
- National Park or National Monument
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service

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7.3.1 Design Option Construction Activities, Workforce and Equipment Requirements

The construction activities, workforce and equipment requirements for the transmission line and terminals would be very similar or the same for the design options as described for the proposed TWE Project in Section 5.8. Construction of each substation or series compensation station would require approximately 135 personnel. The construction activities, workforce and equipment requirements for the substations and series compensation stations for Design Options 2 and 3 would be approximately as shown in Table 13. Special construction methods and Applicant-committed environmental mitigation measures would apply to these alternatives, as presented in Section 5.7.

TABLE 13 ESTIMATED PERSONNEL AND EQUIPMENT FOR DESIGN OPTION SUBSTATIONS

ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT		TRACK OR RUBBER TIRE
Survey Crew	4	2	Pickup trucks	Rubber
Site Management Crew	8-10	2	Office trailers	Rubber
		3	Pickups	Rubber
		4	Generators	Rubber
Site Development – Civil Work Crew	20-25	4	Scrapers	Rubber
		2	Dozers (ripper)	Track
		2	Motor graders	Rubber
		2	Roller compactors	Rubber
		2	Excavators	Either
		4	Dump trucks	Rubber
		3	Water trucks	Rubber
		1	Mechanics truck	Rubber
		1	Fuel truck	Rubber
		2	Pickup trucks	Rubber
		6	Carry alls	Rubber
Fence Installation Crew	10-15	1	Pickup truck	Rubber
		1	Boom truck	Rubber
		2	Carry alls	Rubber
		1	Backhoe	Either
		1	Concrete truck	Rubber
		1	Reel stand truck	Rubber
		2	Bobcats	Either
Equipment Footings Installation Crew	20-25	2	Hole diggers	Either
		2	Boom trucks	Rubber
		1	Excavator	Either

ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT		TRACK OR RUBBER TIRE
		3	Concrete trucks	Rubber
		1	Dump truck	Rubber
		1	Roller compactor	Rubber
		2	Plate compactors	---------
		1	Backhoe	Either
		2	Bobcats	Either
		1	Mechanics truck	Rubber
		1	Fuel truck	Rubber
		1	Water truck	Rubber
		2	Pickup trucks	Rubber
		4	Carry alls	Rubber
Cable Trench, Conduits, and Station Grounding Crew	10-12	2	Trenchers	Either
		2	Dozers (ripper)	Track
		2	Roller compactors	Rubber
		2	Plate compactors	---------
		2	Excavators	Either
		1	Boom truck	Rubber
		3	Pickup trucks	Rubber
		2	Flatbed trucks	Rubber
		4	Carry alls	Rubber
		1	Air compressor	Rubber
		1	Backhoe	Either
		1	Mechanics truck	Rubber
		1	Fuel truck	Rubber
		1	Dump truck	Rubber
		1	Reel stand truck	Rubber
Steel Structure and Bus Installation Crew, Control Buildings Construction Crew, Equipment Assembly and Erection Crew	16-24	2	Cranes, RT	Either
		2	High capacity cranes	Either
		4	Boom trucks	Either
		6	Manlifts	Either
		4	Welder trucks	Rubber
		2	Carry alls	Rubber
		3	Pickup trucks	Rubber
		2	Flatbed trucks	Rubber

ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT		TRACK OR RUBBER TIRE
		1	Mechanics truck	Rubber
		4	Vans	Rubber
		2	Flatbed trucks	Rubber
Control Building and Wiring Crew	16-20	2	Boom trucks	Rubber
		4	Manlifts	Either
		3	Wire pullers-small	Rubber
		2	Reel stand trucks/trailers	Rubber
		4	Vans	Rubber
		4	Pickup trucks	Rubber
		2	Carry alls	Rubber
		1	Splicing van	Rubber
		2	Concrete trucks	Rubber
		1	Bobcat	Either
		1	Trencher	Either
		2	Plate compactors	---------

The above table reflects estimated personnel requirements, which may reach as high as 135 for each substation or series compensation station construction, including maintenance, management, and quality control personnel.

7.3.2 Design Option Construction Schedules

The conceptual construction schedule for the transmission line for Design Option 2 would employ a three spread approach very similar to the schedule presented for the proposed TWE Project in Section 5.8.1 and shown on Figure 18. For Design Option 2, the conceptual construction schedules shown in Figure 18 would need to be increased by approximately ten weeks to accommodate the additional work required for installing an AC transmission line in place of a DC transmission line.

The conceptual construction schedule for the transmission lines for Design Option 3 follows a phased approach and is shown on Figure 25. The conceptual construction schedule shown on Figure 25 would be used for both Phase 1 and Phase 2 of Design Option 3.

The construction schedules for the terminal, ground electrodes, substations and series compensation stations for Design Options 2 and 3 would differ from the proposed TWE Project, as illustrated on Figures 23 and 24.

7.3.3 Induced Currents on Adjacent Facilities

Unlike the proposed TWE Project ±600 kV DC transmission line, which presents no risk of inducing currents line due to the static nature of the DC electrical and magnetic fields, AC transmission systems can induce currents. Mitigation measures for AC inductive currents would be implemented as

necessary for the AC portions of Design Options 2 and 3.[1] Mitigation measures would be incorporated into the siting of the AC transmission line ROWs, as well as through transmission line design and operation measures. Measures to mitigate induced current impacts on pipelines, railroads and other land uses are described in Section 6.2.2. .

[1] The proposed TWE Project includes short sections of AC transmission lines to connect between the terminals and existing and planned AC transmission systems. Potential impacts from AC induced currents on these system interconnection lines would be mitigated, if necessary.

DESIGN OPTION - 2

TOTAL DURATION **111 week**

TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION (NEAR IPP)	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500/345 kV AC SUBSTATION (NEAR IPP)	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
EQUIPMENT INSTALLATION	26
CONTROL BUILDING INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	7
IPP 345 kV AC SUBSTATION MODIFICATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
EQUIPMENT INSTALLATION	17
CONTROL BUILDING MODIFICATION	13
EQUIPMENT TESTING	7
OPERATIONAL	3
SERIES COMPENSATION STATION	
SITE GRADING	10
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
CONTROL HOUSE CONSTRUCTION	17
EQUIPMENT INSTALLATION	16
EQUIPMENT TESTING	10
OPERATIONAL	3

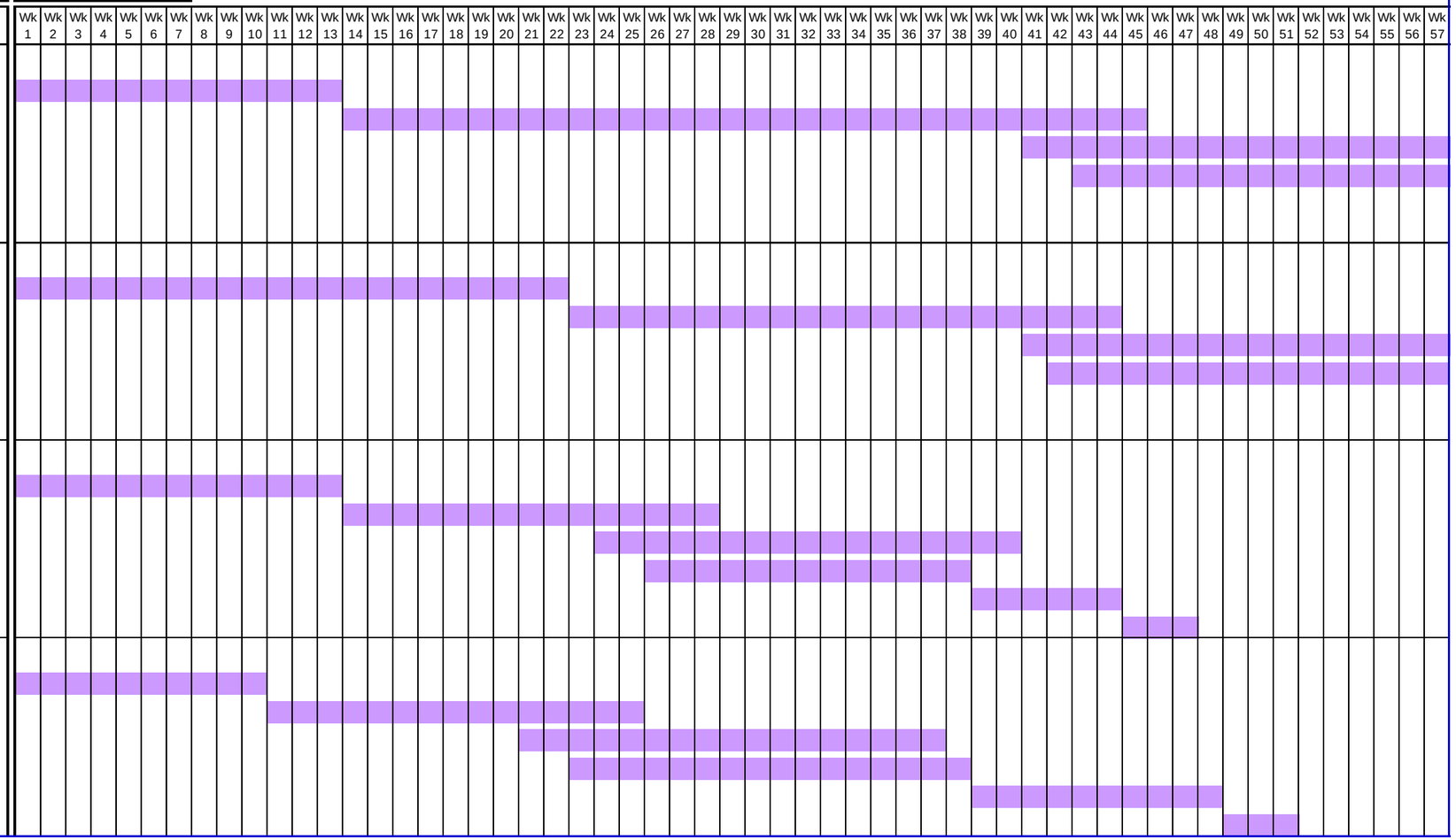

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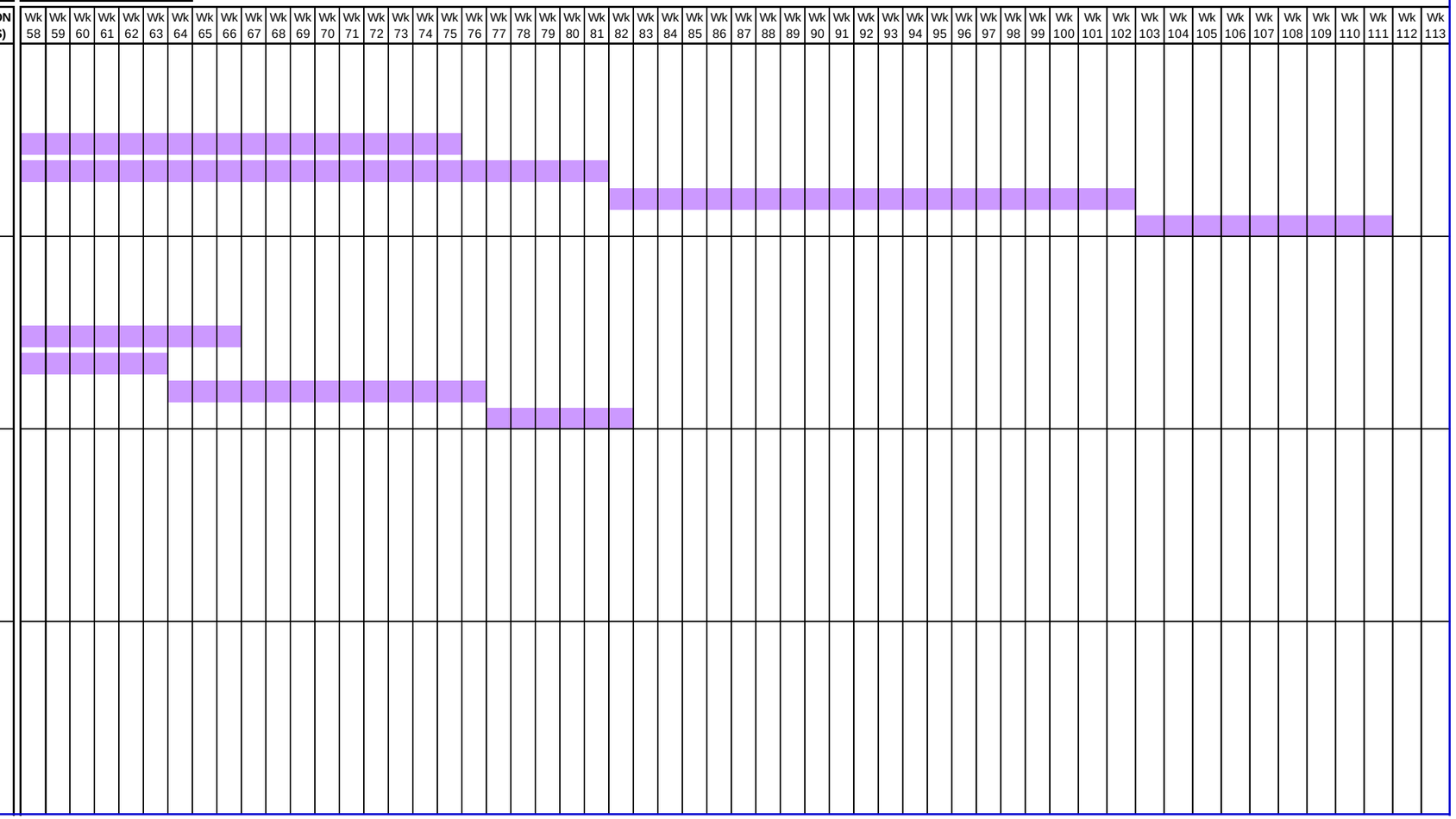
FIGURE 26

CONSTRUCTION SCHEDULE FOR DESIGN OPTION 2 TERMINALS, SUBSTATIONS AND SERIES COMPENSATION STATION – SHEET 1

DESIGN OPTION - 2

TOTAL DURATION **111 week**

TASK	DURATION (WEEKS)
AC/DC CONVERTER STATION (NEAR IPP)	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	32
BUILDING CONSTRUCTION	35
EQUIPMENT INSTALLATION	39
EQUIPMENT TESTING	21
OPERATIONAL	9
500/345 kV AC SUBSTATION (NEAR IPP)	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
EQUIPMENT INSTALLATION	26
CONTROL BUILDING INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	7
IPP 345 kV AC SUBSTATION MODIFICATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
EQUIPMENT INSTALLATION	17
CONTROL BUILDING MODIFICATION	13
EQUIPMENT TESTING	7
OPERATIONAL	3
SERIES COMPENSATION STATION	
SITE GRADING	10
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
CONTROL HOUSE CONSTRUCTION	17
EQUIPMENT INSTALLATION	16
EQUIPMENT TESTING	10
OPERATIONAL	3



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 26

CONSTRUCTION SCHEDULE FOR DESIGN OPTION 2 TERMINALS, SUBSTATIONS AND SERIES COMPENSATION STATION – SHEET 2

DESIGN OPTION - 3

TOTAL DURATION **82 week**

TASK	DURATION (WEEKS)
500/345 kV AC SUBSTATION (NEAR IPP)	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
EQUIPMENT INSTALLATION	26
CONTROL BUILDING INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	7
IPP 345 kV AC SUBSTATION MODIFICATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
EQUIPMENT INSTALLATION	17
CONTROL BUILDING MODIFICATION	13
EQUIPMENT TESTING	7
OPERATIONAL	3
SERIES COMPENSATION STATION	
SITE GRADING	10
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
CONTROL HOUSE CONSTRUCTION	17
EQUIPMENT INSTALLATION	16
EQUIPMENT TESTING	10
OPERATIONAL	3

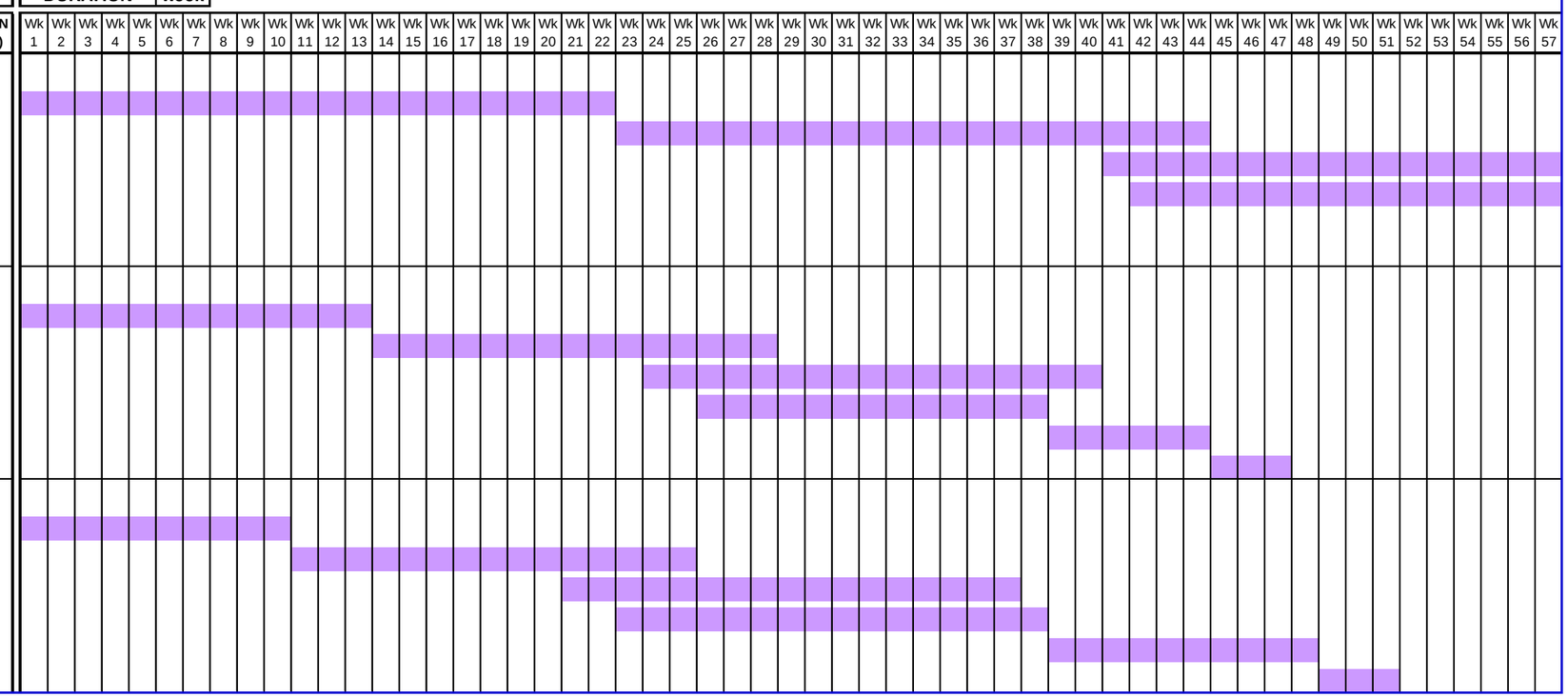

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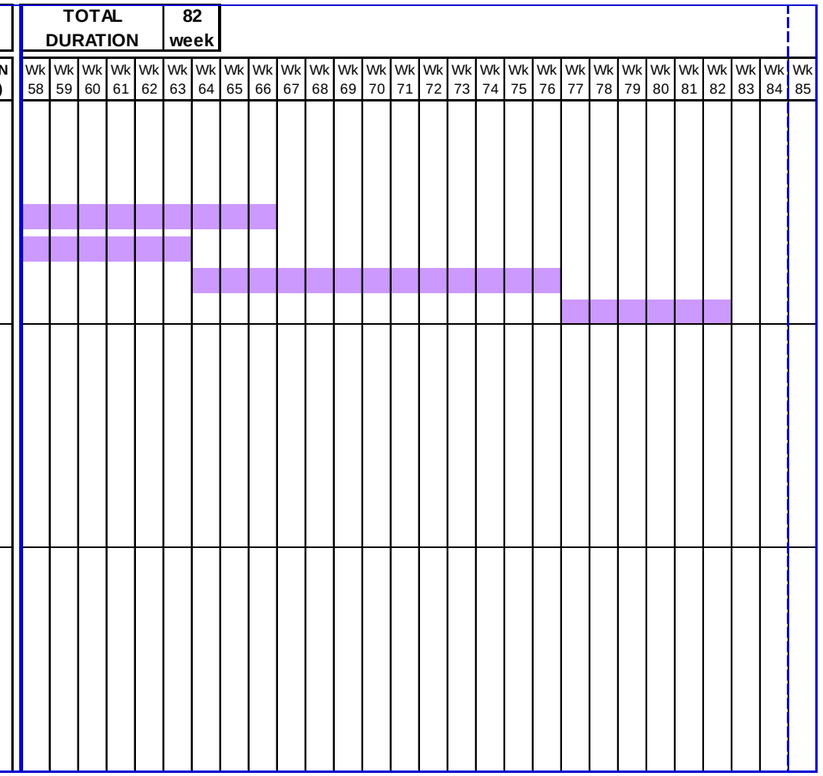
FIGURE 27
CONSTRUCTION SCHEDULE FOR DESIGN OPTION 3 SUBSTATION AND SERIES COMPENSATION STATION – SHEET 1

DESIGN OPTION - 3

TOTAL DURATION 82 week

TASK	DURATION (WEEKS)
500/345 kV AC SUBSTATION (NEAR IPP)	
SITE GRADING	22
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	22
EQUIPMENT INSTALLATION	26
CONTROL BUILDING INSTALLATION	22
EQUIPMENT TESTING	13
OPERATIONAL	7
IPP 345 kV AC SUBSTATION MODIFICATION	
SITE GRADING	13
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
EQUIPMENT INSTALLATION	17
CONTROL BUILDING MODIFICATION	13
EQUIPMENT TESTING	7
OPERATIONAL	3
SERIES COMPENSATION STATION	
SITE GRADING	10
BELOW-GRADE WORK (FOUNDATIONS, CONDUIT, GROUNDING)	15
CONTROL HOUSE CONSTRUCTION	17
EQUIPMENT INSTALLATION	16
EQUIPMENT TESTING	10
OPERATIONAL	3



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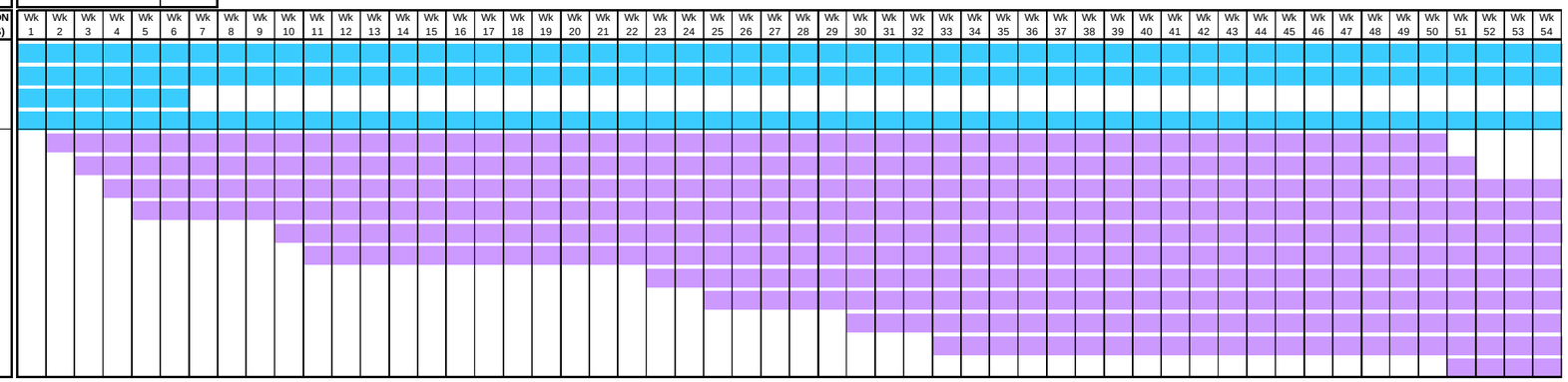
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 27
CONSTRUCTION SCHEDULE FOR DESIGN OPTION 3 SUBSTATION AND SERIES COMPENSATION STATION – SHEET 2

SECTION 1
NORTHERN TERMINAL - NORTHEASTERN UTAH

TOTAL DURATION: 122 weeks

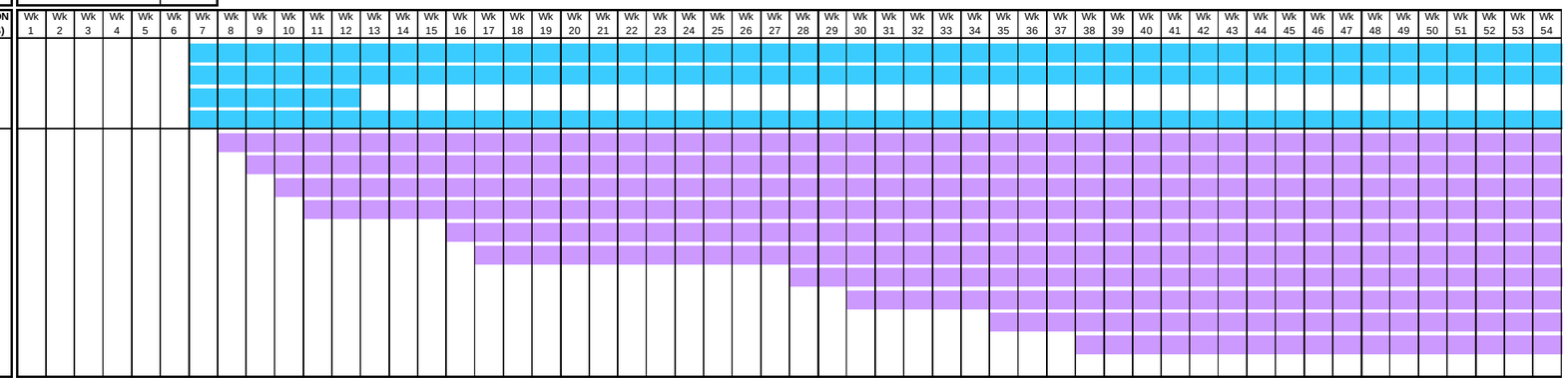
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	67
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	70
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	70
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	66
ERECT SELF SUPPORTING LATTICE STRUCTURE	72
WIRE INSTALLATION	85
FINAL CLEAN UP / RECLAMATION / RESTORATION	70



SECTION 2
NORTHEASTERN UTAH - WEST CENTRAL UTAH

TOTAL DURATION: 124 weeks

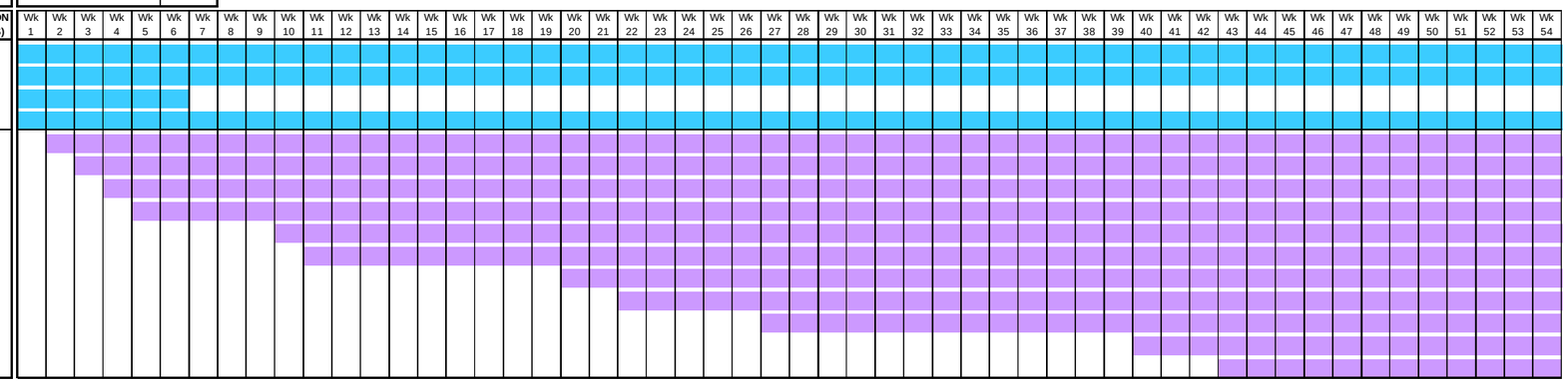
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	72
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	72
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	63
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	68
ERECT SELF SUPPORTING LATTICE STRUCTURE	74
WIRE INSTALLATION	88
FINAL CLEAN UP / RECLAMATION / RESTORATION	72



SECTION 3
WEST CENTRAL UTAH - SOUTHERN TERMINAL

TOTAL DURATION: 140 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	140
INSPECTION	138
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	138
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	66
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	66
GEOLOGICAL INVESTIGATIONS	76
SURVEY / STAKE STRUCTURE LOCATIONS	76
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	90
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	90
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	83
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	83
ERECT SELF SUPPORTING LATTICE STRUCTURE	96
WIRE INSTALLATION	84
FINAL CLEAN UP / RECLAMATION / RESTORATION	96



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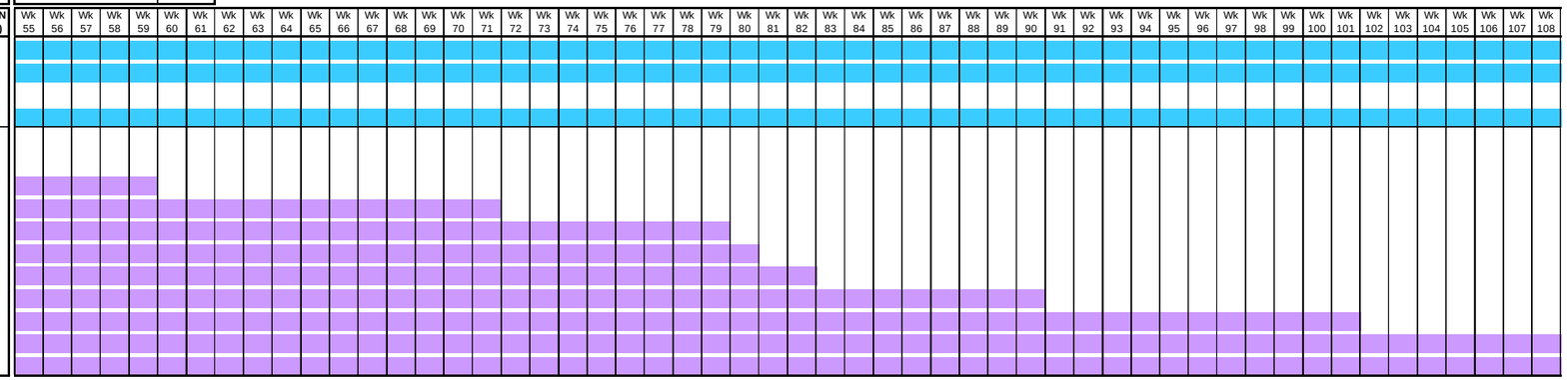
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 28

CONSTRUCTION SCHEDULE FOR
DESIGN OPTION 3 TRANSMISSION LINE
SHEET 1

SECTION 1
NORTHERN TERMINAL - NORTHEASTERN UTAH

TOTAL DURATION: 111 weeks

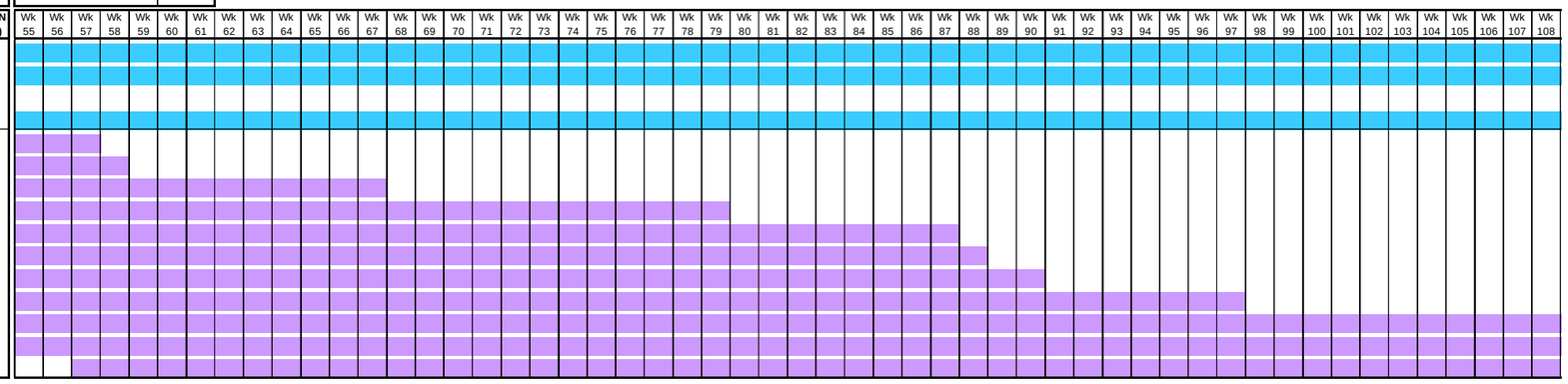
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	67
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	70
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	70
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	66
ERECT SELF SUPPORTING LATTICE STRUCTURE	72
WIRE INSTALLATION	85
FINAL CLEAN UP / RECLAMATION / RESTORATION	70



SECTION 2
NORTHEASTERN UTAH - WEST CENTRAL UTAH

TOTAL DURATION: 124 weeks

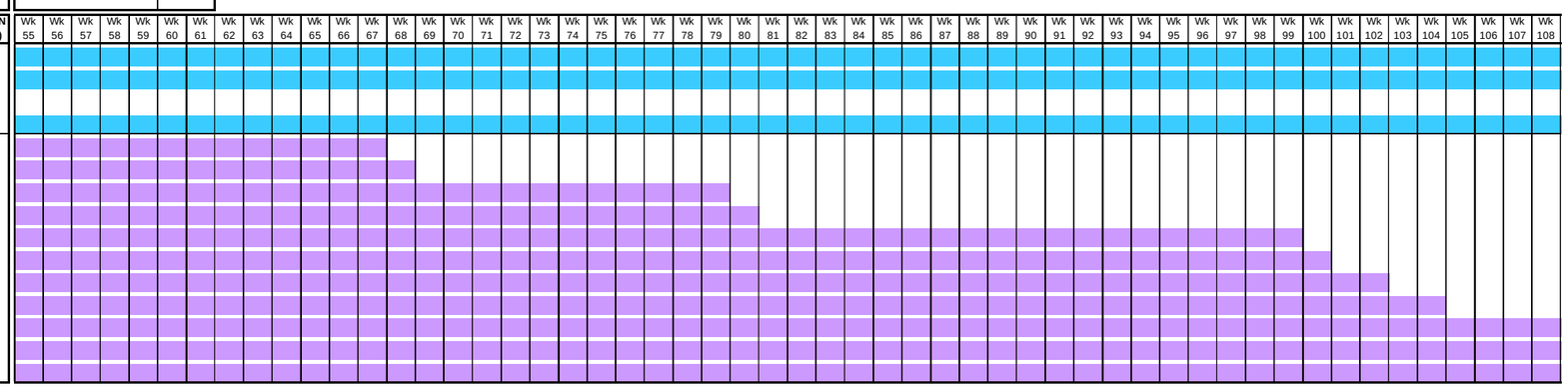
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	72
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	72
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	63
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	68
ERECT SELF SUPPORTING LATTICE STRUCTURE	74
WIRE INSTALLATION	88
FINAL CLEAN UP / RECLAMATION / RESTORATION	72



SECTION 3
WEST CENTRAL UTAH - SOUTHERN TERMINAL

TOTAL DURATION: 140 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	140
INSPECTION	138
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	138
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	66
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	66
GEOLOGICAL INVESTIGATIONS	76
SURVEY / STAKE STRUCTURE LOCATIONS	76
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	90
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	90
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	83
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	83
ERECT SELF SUPPORTING LATTICE STRUCTURE	96
WIRE INSTALLATION	84
FINAL CLEAN UP / RECLAMATION / RESTORATION	96



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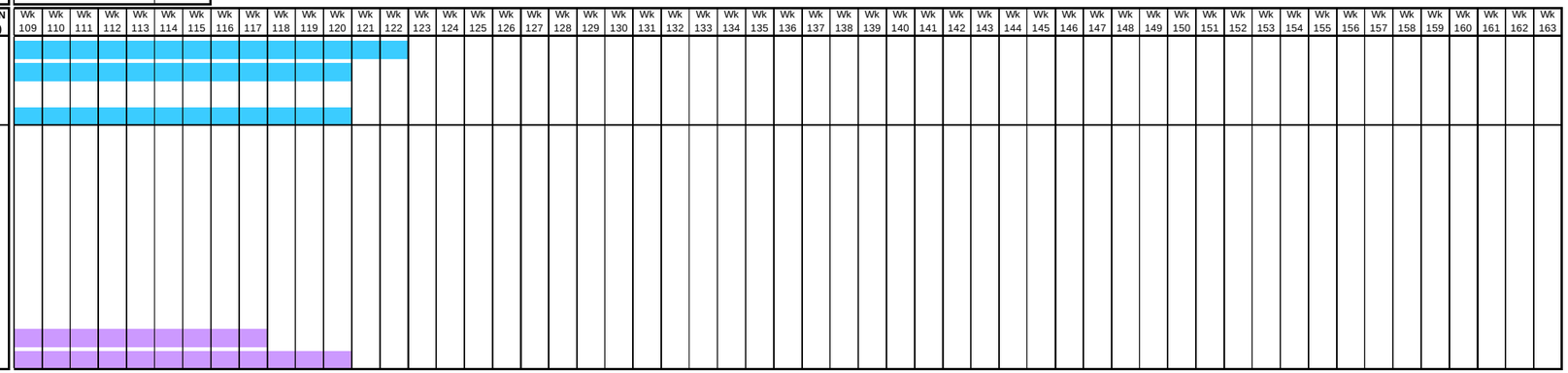
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 28

CONSTRUCTION SCHEDULE FOR
DESIGN OPTION 3 TRANSMISSION LINE
SHEET 2

SECTION 1
NORTHERN TERMINAL - NORTHEASTERN UTAH

TOTAL DURATION: 122 weeks

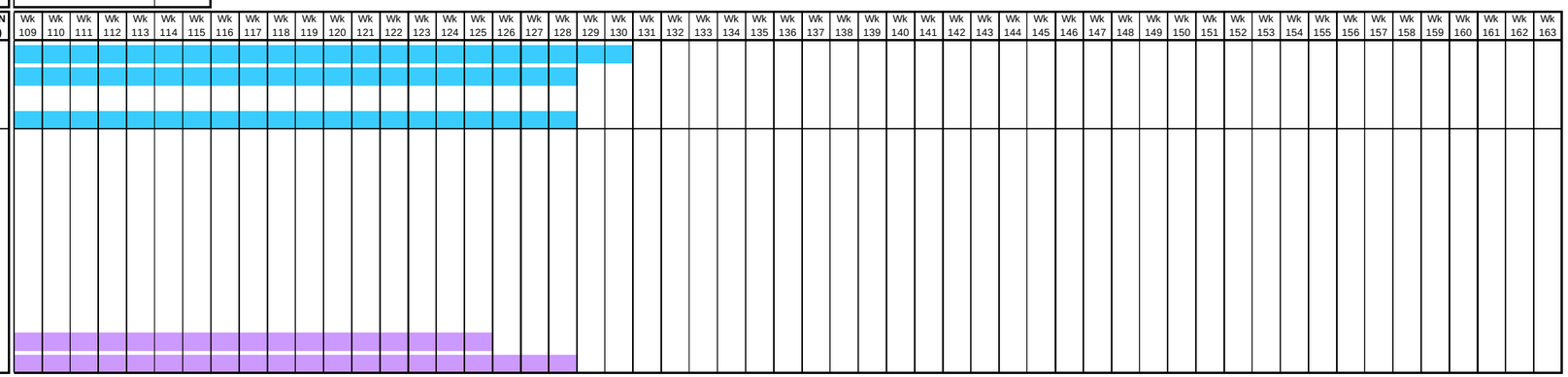
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE LOCATIONS	67
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	70
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	70
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	60
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	66
ERECT SELF SUPPORTING LATTICE STRUCTURE	72
WIRE INSTALLATION	85
FINAL CLEAN UP / RECLAMATION / RESTORATION	70



SECTION 2
NORTHEASTERN UTAH - WEST CENTRAL UTAH

TOTAL DURATION: 124 weeks

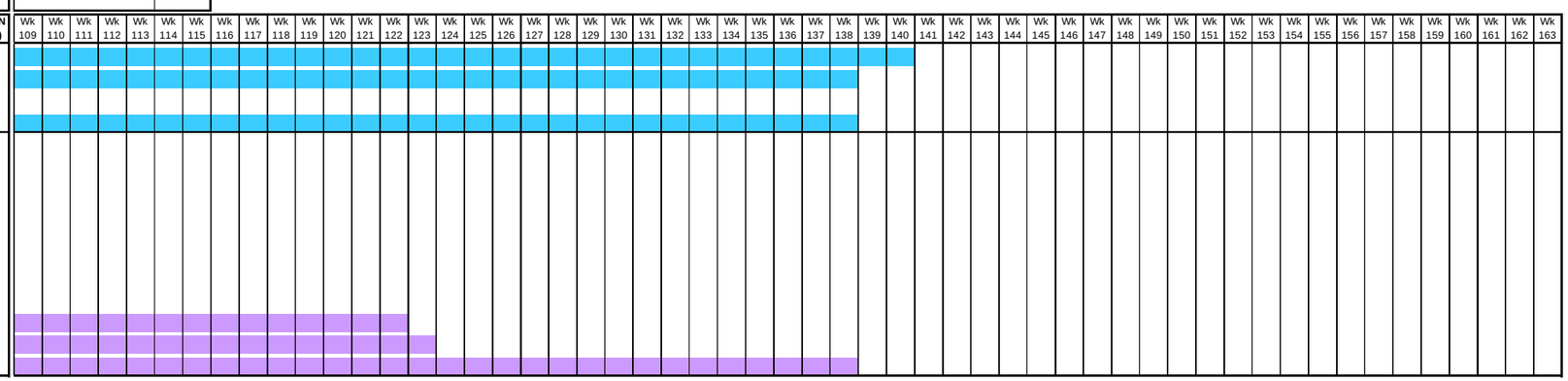
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE LOCATIONS	69
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	72
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	72
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	63
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	68
ERECT SELF SUPPORTING LATTICE STRUCTURE	74
WIRE INSTALLATION	88
FINAL CLEAN UP / RECLAMATION / RESTORATION	72



SECTION 3
WEST CENTRAL UTAH - SOUTHERN TERMINAL

TOTAL DURATION: 140 weeks

TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	140
INSPECTION	138
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	138
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	66
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	66
GEOLOGICAL INVESTIGATIONS	76
SURVEY / STAKE STRUCTURE LOCATIONS	76
EXCAVATE HOLES FOR SELF SUPPORTING LATTICE STRUCTURE	90
INSTALL FOUNDATIONS FOR SELF SUPPORTING LATTICE STRUCTURE	90
HAUL MATERIALS FOR SELF SUPPORTING LATTICE STRUCTURE	83
ASSEMBLE SELF SUPPORTING LATTICE STRUCTURE	83
ERECT SELF SUPPORTING LATTICE STRUCTURE	96
WIRE INSTALLATION	84
FINAL CLEAN UP / RECLAMATION / RESTORATION	96



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 28

CONSTRUCTION SCHEDULE FOR
DESIGN OPTION 3 TRANSMISSION LINE
SHEET 3

7.4 Comparison of Proposed TWE Project to Design Options

Table 14 provides a comparison summary of Design Options 2 and 3 to the proposed TWE Project.

TABLE 14 COMPARISON OF PROPOSED TWE PROJECT TO DESIGN OPTIONS

COMPARISON FACTORS	PROPOSED TWE PROJECT	DESIGN OPTION 2	DESIGN OPTION 3
TWE Project Configuration	Two-terminal ±600 kV DC transmission line between WY and NV with potential interconnection to IPP system near Delta, UT.	Two terminal ±600 kV DC transmission line between WY and IPP system near Delta, UT. Two terminal single circuit 500 kV AC transmission line between Delta, UT and NV.	Phased Approach Phase 1 – Two terminal 500 kV AC (±600 kV DC) line between WY and IPP near Delta, UT. Phase 2 – proposed TWE Project. Involves building DC line from IPP to Marketplace and two AC/DC converter stations.
Contingencies for Design Options	N/A	Capacity available in the future on IPP STS to serve Desert Southwest.	Capacity available in the future on IPP STS to serve Desert Southwest. The need for transmission capacity requires a phased implementation.
Current Status of System Contingencies and Design Options	N/A	Future available capacity on the IPP STS is uncertain. Therefore, the status of Design Option 2 is uncertain.	Future available capacity on the IPP STS is uncertain. Currently, all of the TWE Project's 3,000 MW of capacity is needed by the projected in-service date. It is unlikely Design Option 3 will be pursued.
Routing Alternatives	As part of the EIS preparation, the BLM and Western have established four regions for the TWE Project route. Each region has a distinct set of Route Alternatives.	The TWE Project route region and all Route Alternatives for each region all apply to Design Option 2.	The TWE Project route region and all Route Alternatives for each region all apply to Design Option 3.
System Capacity	3,000 MW between WY and NV	3,000 MW between WY and UT 1,500 MW between UT and NV	Phase 1 - 1,500 MW between WY and UT Phase 2 - 3,000 MW between WY and NV
Typical Transmission Line Towers Used	Guyed or self-supporting lattice towers holding up <u>two conductor bundles</u> for entire Project.	Guyed or self-supporting lattice towers holding up <u>two conductor bundles</u> between WY and Delta, UT. Guyed or self-supporting lattice towers holding up <u>three conductor bundles</u> between Delta, UT and NV.	Guyed or self-supporting lattice towers holding up <u>three conductor bundles</u> between WY and Delta, UT. Guyed or self-supporting lattice towers holding up <u>two conductor bundles</u> between Delta, UT and NV.

COMPARISON FACTORS	PROPOSED TWE PROJECT	DESIGN OPTION 2	DESIGN OPTION 3
Terminals - AC/DC Converter Stations	Northern Terminal near Sinclair, WY. Southern Terminal at Marketplace Hub near Boulder City, NV.	Northern Terminal same as proposed TWE Project. Southern Terminal near the IPP near Delta, UT.	Phase 1 – no AC/DC Converter Stations Phase 2 - Same as proposed TWE Project.
TWE Project Interconnections	Northern Terminal will interconnect with existing 230 kV line and one (two total) 500 kV circuit of the Energy Gateway West and Energy Gateway South projects. Southern Terminal will interconnect with the existing 500 kV AC substations (up to 4 total) at the Marketplace Hub near Boulder City, NV. Potential interconnection with IPP system near Delta, UT.	Same as proposed TWE Project for Northern Terminal. Southern Terminal would be located near Delta, UT and would be interconnected to the IPP transmission system, and the TWE Project 500 kV AC line. The TWE Project 500 kV AC line would interconnect with one of the existing 500 kV AC substations at the Marketplace Hub near Boulder City, NV.	Phase 1 – The TWE Project 500 kV AC line would interconnect with the existing 230 kV line and the 500 kV Energy Gateway West and Energy Gateway South lines in WY and with the IPP Substation near Delta, UT. Phase 2 – same as the proposed TWE Project.
Related Structures and Facilities	Fiber optic network communications system. Two ground electrode facilities near terminals.	Same as the proposed TWE Project, however, ground electrode facility would be within 50 miles of the Southern Terminal near IPP Substation, Delta, UT.	Phase 1 – Fiber optic network communications system between WY and NV. No ground electrode. Phase 2 - Same as proposed TWE Project.

8.0 ENVIRONMENTAL MITIGATION MEASURES

8.1 Introduction

This section of the FEIS POD describes the framework for the environmental compliance program to be implemented for the TWE Project.

Prior to construction, TransWest will prepare the NTP POD, which will incorporate environmental measures and terms and conditions stipulated in the RODs, ROW grants and special use authorizations issued by each federal agency. The NTP POD will provide detailed information on the TWE Project's construction plans and specifications, and construction practices and procedures for the selected alternative. It will also describe the processes and procedures TransWest will employ to comply with the requirements of the RODs, ROW grants, and special use authorizations and include the final Environmental Compliance and Monitoring Plan. A framework Environmental Compliance and Monitoring Plan is provided in Appendix G.

Below is a list of specific framework plans which are part of this FEIS POD. The process leading to a set of final plans is iterative. Initial (framework) plans are based upon preliminary engineering and design of all alternatives analyzed in the FEIS, potential impacts disclosed in the DEIS, and proposed BMPs and mitigation measures. Final plans will be based upon final engineering and design of the selected alternative and requirements and terms and conditions of the RODs, ROW grants, special use authorizations and any other required permits. Framework plans describe the process to be followed and matters to be considered in preparing the final plans for the selected alternative. These framework plans are an intermediate step and establish the structure of each plan.

- Appendix A: Access Road Siting and Management Plan
- Appendix B: Avian Protection Plan
- Appendix C: Blasting Plan
- Appendix D: Cultural Resources Protection and Management Plan
- Appendix E: Dust Control and Air Quality Plan
- Appendix F: Emergency Preparedness and Response Plan
- Appendix G: Environmental Compliance and Monitoring Plan
- Appendix H: Fire Protection Plan
- Appendix I: Flagging, Fencing, and Signage Plan
- Appendix J: Geotechnical Plan
- Appendix K: Greater Sage-Grouse Mitigation Plan
- Appendix L: Hazardous Materials Management Plan
- Appendix M: Health and Safety Plan

- Appendix N: Noxious Weed Management Plan
- Appendix O: Operations and Maintenance Plan
- Appendix P: Paleontological Resources Management and Mitigation Plan
- Appendix Q: Reclamation Plan
- Appendix R: ROW Preparation and Vegetation Management Plan
- Appendix S: Spill Prevention and Response Plan
- Appendix T: Stormwater Pollution Prevention Plan
- Appendix U: Traffic and Transportation Management Plan
- Appendix V: Visual Resources Management Plan
- Appendix W: Water Resources Protection Plan
- Appendix X: Wildlife and Plant Conservation Measures Plan

8.2 POD Implementation on Public/Private Lands

The NTP POD will outline the stipulations, terms and conditions, and mitigation measures set forth in the RODs, ROW grants, special use authorizations and other required permits that must be followed during construction, operation, and maintenance of the Project. The POD is intended to be used Project-wide as (1) a summary of Project environmental requirements and protection measures, and (2) a description of the processes and procedures that will be used to ensure compliance (including the requirements of the U.S. Fish and Wildlife Service, BLM, USFS, and other federal, state, and/or local agencies) as appropriate.

The POD will be an enforceable stipulation of the ROD and the BLM ROW grant. The USFS may choose to make the POD or a similar document enforceable as part of the ROD, or special use authorization (SUA). The POD applies not only to construction of the Project, but also to the operation and maintenance phase of the Project. The BLM and USFS have jurisdiction over all lands under the administrative control of each of respective agency.

8.3 Overview of Mitigation Measures

Table 15 outlines the Applicant committed environmental mitigation measures proposed by TransWest that are being taken into account to reduce impacts to environmental resources. Mitigation measures are organized by major resource topics. These measures are part of the proposed TWE Project, and would be common to all the FEIS alternatives. Table 15 identifies the phase(s) during which each measure would be implemented:

- P – planning and engineering design
- C – construction
- O – operation and maintenance
- D – decommissioning

Mitigation measures include general mitigation measures, which would apply to the TWE Project as a whole; and selective mitigation measures, which would be implemented on a case-by-case basis to address specific environmental impacts or localized conditions. The mitigation measures will be updated through the NEPA process to incorporate appropriate selective mitigation measures. Note that the Construction, Operation and Maintenance Plan will be a part of the NTP POD.

TABLE 15 APPLICANT COMMITTED ENVIRONMENTAL MITIGATION MEASURES

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
General Measures			
TWE-1	P	General, compliance with agency stipulations and RODs	The TWE Project will be planned, constructed, operated, and decommissioned in accordance with the agencies' Records of Decision (RODs) the U.S. Bureau of Land Management's (BLM) ROW Grant stipulations, U.S. Forest Service (USFS) Special Use Permit stipulations, and requirements of other permitting agencies.
TWE-2	P	General, compliance with laws and regulations	The Applicant will comply with all applicable environmental laws and regulations. Applicable laws and regulations may include, but are not limited to, the Clean Water Act (CWA) Section 303(d) and Section 404; the Wild and Scenic Rivers Act, Section 3(a) or 2(s)ii; the Endangered Species act (ESA), Section 7; the National Historic Preservation Act (NHP), Section 106; and the Native American Graves Protection and Repatriation Act (NAGPRA). Compliance with all applicable laws and regulations will be documents in the Final Plan of Development (POD)/Construction, Operation and Maintenance (COM) Plan.
TWE-3	P	General, mitigation monitoring plan	The POD will include a mitigation monitoring plan that will address how each mitigation measure required by permitting agencies in their respective decision documents and permits will be monitored for compliance.
TWE-4	P	General, environmental training	Prior to construction, all personnel will be instructed on the protection of cultural, paleontological, ecological resources, and other natural resources in accordance with the POD provisions. To assist in this effort, the construction contract would address (a) federal, state , and tribal laws regarding cultural resources, fossils, plants, and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
Project Design, Access, and Construction			
TWE-5	P	General, compliance with laws and regulations	The POD will display the location of Project infrastructure (e.g., towers, access roads, substations) and identify short-term and long-term land and resource impacts and the mitigation measures that will be implemented for the site-specific and resource-specific environmental impacts.
TWE-6	P	General, Access Road Plan	The POD will include an Access Road Siting and Management Plan that incorporates relevant agency standards regarding road design, construction, maintenance, and decommissioning. The Access Road Siting and Management Plan will incorporate best management practices, stipulated by the agencies in their respective decision documents and permits.
TWE-7	P	Access, visual	The alignment of any new access roads will follow the designated area's landform contours where practical, providing that such alignment does not additionally impact resource values. This will minimize ground disturbance and reduce scarring (visual contrast).
TWE-8	P,C	Access, tower placements, surface water, vegetation management, drainage, dust control	Crossings of streams and waterways will be done in compliance with federal, state, and local regulations. Roads will be built as near as possible at right angles to the streams and washes (Arizona crossing). Culverts will be installed where necessary. All construction and maintenance activities will be conducted in a manner that will minimize disturbance to vegetation, drainage channels, and intermittent or perennial stream banks. In addition, fugitive dust will be controlled during road construction as required by state and local permits. All existing roads will be left in a condition equal to, or better than, their condition prior to the construction of the transmission line. Structures will be sited with a minimum distance of 200 feet from streams, wherever possible.
TWE-9	C,O	Access	All construction vehicle movement outside the ROW will be restricted to pre-designated access or public roads.

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
TWE-10	P,C	General ROW, visual	The area limits of construction activities will be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents will be applied to rocks or vegetation to indicate survey or construction activity limits.
TWE-11	P,C	Access, visual	In construction areas where pre-contouring is not required, vegetation will be left in place, wherever possible, and original contour will be maintained to avoid excessive root damage and to allow for re-sprouting.
TWE-12	P,C,O	Access, soils, vegetation, water, cultural visual resources	Except for repairs necessary to make roads passable, no widening or upgrading of existing access roads will be undertaken in the area of construction and operation, where soils or vegetation are sensitive to disturbance. In designated areas, structures will be placed to avoid sensitive features such as, but not limited to, riparian areas, water courses and cultural sites, or to allow conductors to clearly span the features within limits of standard structure design. This will minimize the amount of disturbance to the sensitive features or reduce visual contrast.
TWE-13	C	Vegetation management, restoration, erosion control	In construction areas (e.g., marshalling yards, structure sites, spur roads from existing access roads) where ground disturbance is significant or where re-contouring is required, surface restoration will occur as required by the landowner or land management agency. The method of restoration will normally consist of returning disturbed areas back to their natural contour, reseeding (if required), installing cross drains for erosion control, placing water bars in the road, and filling ditches.
TWE-14	P,C	General, soils, erosion control, visual	The POD will show the location of borrow sites, from which material will be obtained. Borrow pits will be stripped of topsoil to a depth of approximately six inches. Stripped topsoil will be stockpiled and, upon completion of borrow excavation, spread to a uniform depth of six inches over areas of borrow pits from which removed. Before replacing topsoil, excavated surfaces will be reasonably smooth and uniformly sloped. The sides of borrow pits will be brought to stable slopes with slope intersection shaped to carry the natural contour of adjacent undisturbed terrain into the pit to give a natural appearance. When necessary, borrow pits will be drained by open ditches to prevent accumulation of standing water.
TWE-15	C	Flagging, Fencing and Signage	The POD will include a Flagging, Fencing, and a Signage Plan. Except for permanent survey markers and material that locate proposed facilities, stakes, pins, rebar, spikes, and other material will be removed from the surface and within the top 15 inches of the topsoil as part of final clean-up. The Applicant will adhere to BLM fencing standards where required. Fences on ROW will be removed where necessary and replaced to the original condition or better when the work is finished. Where existing fences are removed to facilitate the work, temporary fence protection for lands adjacent to the ROW will be provided at all times during the continuation of the Contract. Such temporary fence protection will be adequate to prevent public access to restricted areas. Temporary fencing constructed on the ROW will be removed by the Contractor as part of the clean-up operations prior to final acceptance of the completed work.
TWE-16	C	Site restoration and clean-up, water resources, land use	Watering facilities (tanks, natural springs and/or developed springs, water lines, wells, etc.) will be repaired or replaced, if damaged or destroyed by construction activities, to their pre-disturbed condition as required by the landowner or land management agency.
TWE-17	C	Site restoration and clean-up	Existing vegetation such as landscape plants, gardens, and field crops, which are damaged by the application of the soil-applied herbicide, will be replaced by the Contractor at its expense.

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
TWE-18	C	Site clean-up	The Applicant will pay fair market value to the land management agency for any merchantable forest products that will be cut during ROW clearing. Merchantable forest products will either be removed or stacked at locations determined by the land management agency.
Geology and Soils			
TWE-19	C	Drainage, soil erosion control	The POD will include an Erosion Control Plan as part of the Stormwater Pollution Prevention Plan (SWPPP). Grading will be performed to provide adequate drainage around structure sites and sufficient clearance under conductors. Excavated material will be spread around the site where it was excavated. Topsoil will be piled separately and replaced after work completion.
Groundwater, Surface Water and Wetlands			
TWE-20	P	Water quality	As part of the Clean Water Act (CWA) 404 Permit for the TWE Project, the POD will include a Water Resources Protection Plan, which will incorporate measures to avoid and minimize impacts to wetlands and waters of the U.S. to the extent practical. The POD will include a SWPPP. The Applicant will identify all streams in the vicinity of the proposed project sites that are listed as impaired under Section 303(d) of the CWA and develop a management plan to avoid, reduce, and/or minimize adverse impacts to those streams.
TWE-21	P	Water quality	The Applicant will obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Environmental Protection Agency (EPA) prior to construction.
TWE-22	C	Water quality	Runoff from excavated areas, construction materials or wastes (including truck washing and concrete washes), and chemical products such as oil, grease, solvents, fuels, and pesticides will be controlled. Excavated material or other construction material will not be stockpiled or deposited near or on stream banks, lake shorelines, ditches, irrigation canals, or other areas where runoff could impact the environment.
TWE-23	C	Water quality	Washing of concrete trucks or disposal of excess concrete in any ditch, canal, stream, or other surface water will not be permitted. Concrete wastes will be disposed of in accordance with all federal, state and local regulations.
TWE-24	C,O	Surface water, wetlands	Vehicle refueling and servicing activities will be performed in designated construction zones located more than 100 feet from wetlands and intermittent streams and more than 500 feet from perennial streams. Spill prevention and containment measures or practices will be incorporated as needed.
TWE-25	P	Dewatering	A dewatering permit will be obtained from the appropriate agencies if required for construction dewatering activities.
Vegetation and Soils Management			
TWE-26	P,C	Vegetation management and noxious weeds	The POD will include a Reclamation Plan and a Noxious Weed Management Plan. The Reclamation Plan will address plant removal and selective clearing. The Noxious Weed Management Plan will be developed in accordance with appropriate land management agencies' standards, consistent with applicable regulations and agency permitting stipulations for the control of noxious weeds and invasive species (Executive Order [E.O.] 13112). Included in the Noxious Weed Management Plan will be stipulations regarding construction, restoration, and operation (use of weed-free materials, washing of equipment, etc.).
TWE-27	C	Vegetation management	In construction areas where re-contouring is not required, vegetation will be left in place wherever possible and original contour will be maintained to avoid excessive root damage and allow for re-sprouting.

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
TWE-28	C	Vegetation management, visual	Clearing will be performed in a manner that minimizes the marring and scarring of the countryside and preserves the natural beauty to the maximum extent possible. Except for danger trees, no clearing will be performed outside the limits of the ROW.
Ecological Resources			
TWE-29	P,C	Ecological, special status species	The POD will include a Wildlife and Plant Conservation Measures Plan, which will identify important, sensitive, or unique habitats and BLM sensitive, USFS sensitive, and state-listed species in the vicinity of the TWE Project. The POD will identify measures to be taken to avoid, minimize, or mitigate impacts to these habitats and species.
TWE-30	P	Ecological, raptors	In applicable areas, the TWE Project will be designed to meet or exceed the raptor safe design standards described in the Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006 (Avian Power Line Interaction Committee [APLIC] 2006).
TWE-31	P,C,O	Ecological, special status species	Mitigation measures that will be developed during the consultation period with the BLM and the U. S. Fish and Wildlife Service under Section 7 of the ESA will be adhered to, along with mitigation developed in conjunction with state authorities.
TWE-32	P,C, D	Ecological, special status species	Seasonal restrictions may be implemented in certain areas to mitigate impacts on wildlife. With the exception of emergency repair situations, the activities of ROW construction, restoration, maintenance, and decommissioning will be modified or discontinued in designated areas during sensitive periods (e.g., nesting and breeding periods) for candidate, proposed of listed threatened or endangered, or other sensitive animal species, as required by permitting agencies. Potential seasonal restrictions and avoidance buffers for nesting raptors will be identified in the DEIS. The Wildlife and Plant Conservation Measures Plan will incorporate the seasonal restrictions and stipulations contained in the federal agency RODs.
TWE-33	P,C	Ecological, special status species and habitats	Prior to the start of construction, the Applicant will provide training to all Contractor and Subcontractor personnel and others involved in construction activities where/if there is a known occurrence of protected species or habitat in the construction area. Sensitive areas will be considered avoidance areas. Prior to any construction activity, avoidance areas will be marked on the ground and maintained through the duration of the Contract. The Applicant will remove markings during or following final inspection of the Project.
TWE-34	C	Ecological, special status species and habitats	If evidence of a protected species not previously identified or known is found in the Project area, the Contractor will immediately notify the appropriate land management agencies and provide the location and nature of the findings.
Cultural Resources – Historic Archaeological, and Tribal Traditional			
TWE-35	P,C	Cultural resources	In consultation with the appropriate land management agencies and state historic preservation officers (SHPOs), and in accordance with the Programmatic Agreement (PA), a Cultural Resources Protection and Management Measures will be prepared as part of the POD to address the specific mitigation measures for cultural resources that will be developed and implemented to mitigate any identified adverse effects. These may include Project modifications to avoid adverse impacts, monitoring of construction activities, and data recovery studies.
TWE-36	P,C	Native American cultural resources	The Applicant will comply with all laws, policies, and regulations pertaining to consultations with federally recognized Tribes.

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
TWE-37	P	General, cultural	Prior to construction and upon the introduction of new construction personnel, all construction personnel will be instructed on the protection of cultural resources, including the provisions of federal, state, and tribal laws regarding the prohibition of collecting and removing cultural resources, and the importance of these resources and the purpose and necessity of protecting them.
Paleontological Resources			
TWE-38	P,C,O	Paleontology	If paleontological resources are known to be present in the Project area, or if areas with a high potential to contain paleontological material has been identified through the NEPA process and DEIS, the Applicant will prepare a Paleontological Resources Management and Mitigation Plan as part of the POD.
TWE-39	P	Paleontology	Paleontological mitigation may be required in areas of greatest disturbance and areas likely to have significant fossils. Preconstruction surveys of such areas may be conducted as agreed upon by the land-managing and lead federal agency.
Land Use and Visual Resources			
TWE-40	P,C,O	Land Use, agriculture	On agricultural land, the ROW will be aligned, in so far as practical, to reduce the impacts to farm operations and agricultural production.
TWE-41	C	Land Use, agriculture	In cultivated agricultural areas, soils that have been compacted by construction activities will be disked to uncompact soils.
TWE-42	C	Land Use, ranching	In grazing areas, excessive amounts of pine needles left by clearing of trees, will be removed from the ROW and disposed of in a location to prevent harm to grazing domestic animals.
TWE-43	C	Access, land use, gates	The POD will include a Flagging, Fencing, and Signage Plan. The Applicant will adhere to BLM fencing standards where required. Fences and gates will be repaired or replaced to their original pre-disturbed condition as required by the landowner or the management agency if they are damaged or destroyed by construction activities. Temporary gates will be installed only with the permission of the landowner or the land management agency, and will be restored to their original pre-disturbed condition following construction. Cattle guards will be installed where new permanent access roads cut through fences, at the request of the land management agency.
TWE-44	P,C,O	Visual	Non-specular conductors will be used to reduce potential visual impacts.
TWE-45	P,C,O	Structure design and public safety	Structures and/or shield/ground wire will be marked with high-visibility devices where required by governmental agencies (Federal Aviation Administration [FAA]). Structure heights will be less than 200 feet, where feasible, to minimize the need for aircraft obstruction lighting.
TWE-46	P,C,O	Visual resources	The Applicant will comply with federal permitting agency stipulations regarding visual resources through development of a Visual Resources Management Plan.
Air Quality			
TWE-47	P,C	Air quality, dust control	The POD will include a Dust Control and Air Quality Plan. Requirements of those entities having jurisdiction over air quality matters will be adhered to and dust control measures will be developed. Open burning of construction trash will not be allowed unless permitted by local authorities.
TWE-48	P,C	Air quality, emissions	The Contractor and Subcontractor(s) will be required to have and use air emissions control devices on construction machinery, as required by federal, state or local regulations or ordinances.

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
Corona Effects			
TWE-49	P,C,O	Corona	Transmission line materials will be designed to minimize corona. The proposed hardware and conductor will limit the audible noise, radio interference, and TV interference due to corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during construction to avoid scratching or nicking the conductor surface that may provide points for corona to occur.
TWE-50	O	TV, radio interference	The Applicant will respond to complaints of line-generated radio or television interference by investigating the complaints and implementing appropriate mitigation measures. The transmission line will be patrolled on a regular basis so that damaged insulators or other line materials that could cause interference are repaired or replaced.
Public Health and Safety			
TWE-51	P,C,O	Safety standards	The TWE project will be designed, constructed and operated to meet or exceed the requirements of the National Electrical Safety Code (NESC), U.S. Department of Labor, Occupational Safety and Health Administration standards, and the Applicant's requirements for safety and protection of landowners and their property.
TWE-52	O	Induced currents	The Applicant will apply necessary mitigation to eliminate problems of induced currents and voltages onto conductive objects sharing ROW, to the mutual satisfaction of the parties involved.
TWE-53	P,C	Blasting	The POD will include a Blasting Plan, which will identify methods and mitigation measures to minimize the effects of blasting, where applicable. The Blasting Plan will document the proposed methods to achieve the desired excavations, proposed methods for blasting warning, use of non-electrical blasting systems, and provisions for controlling fly rock, vibrations, and air blast damage.
TWE-54	P,C,O	Noise, electrostatic, and EMF	Research studies performed to determine the effects of audible noise and electrostatic and electromagnetic fields (EMF) will be regularly monitored by the Applicant to ascertain whether these effects are significant.
TWE-55	P,C,O	FAA regulations	The TWE Project will be designed to comply with FAA regulations, including lighting regulations, to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.
TWE-56	P	Worker health and safety	As part of the POD, the Applicant will provide a Health and Safety Plan, which will outline measures to protect workers and the general public during construction, operation, and decommissioning of the TWE Project. The Heath and Safety Plan will identify applicable federal and state occupational safety standards, establish safe work practices, and define safety performance standards.
Hazardous Materials, Waste, and Wastewater Management			
TWE-57	P	Hazardous materials	As part of the POD, the Applicant will provide a Spill Prevention and Response Plan. The Plan will address compliance with all applicable federal, state and local regulations, and will include: spill prevention measures, notification procedures in the event of a spill, employee awareness training, and commitment of manpower, equipment, and materials to respond to spills, if they occur.
TWE-58	P	Hazardous materials	As part of the POD, the Applicant will provide a Pesticide Use Plan as a component of the Noxious Weed Management Plan. The Plan will address compliance with all applicable federal, state, and local regulations.

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
TWE-59	P	Hazardous materials	As part of the POD, the Applicant will provide a Hazardous Materials Management Plan that has been approved by applicable federal, state or local environmental regulatory agencies. The plan will address on-site excavation of contaminated soils and debris and will include identification of contaminants, methods of excavation, personnel training, safety and health procedures, sampling requirements, management of excavated soils and debris, and disposal methods.
TWE-60	C	Waste management	No non-biodegradable debris will be deposited in the ROW. Slash and other biodegradable debris will be left in place or disposed of in accordance with agency requirements.
TWE-61	C,O	Hazardous materials, waste management	As part of the POD, the Applicant will provide a Hazardous Materials Management Plan. Hazardous materials will not be drained onto the ground or drainage areas. Totally enclosed containments will be provided for all trash. All construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials will be removed to a disposal facility authorized to accept such materials.
TWE-62	C,O	Hazardous materials	If a reportable release of hazardous substance occurs at the work site, the Contractor will immediately notify the Applicant and all environmental agencies, as required by law. The Contractor will be responsible for the clean-up.
Fire Protection			
TWE-64	P,C	Fire, safety	The POD will include a Fire Protection Plan. The Applicant or its Contractor(s) will notify the BLM of any fires and comply with all rules and regulations administered by the BLM and USFS concerning the use, prevention, and suppression of fires on federal lands, including any fire prevention orders that may be in effect at the time of the permitted activity. The Applicant or its Contractor(s) may be held liable for the cost of fire suppression, stabilization, and rehabilitation. In the event of a fire, personal safety will be the first priority of the Applicant or its Contractor(s). The Applicant or its Contractor(s) will: • Operate all internal and external combustion engines on federally-managed lands per 36 CFR Part 261.52(j), which requires all such engines to be equipped with a qualified spark arrester that is maintained and not modified; • Carry shovels, water, and fire extinguishers that are rated at a minimum as ABC-10 pound on all equipment and vehicles. If a fire spreads beyond the suppression capability of workers with these tools, all workers will cease fire suppression action and leave the area immediately via pre-identified escape routes; • Initiate fire suppression actions in the work area to prevent fire spread to or on federally-administered lands. If fire ignitions cannot be prevented or contained immediately, or it may be foreseeable that a fire would exceed the immediate capability of workers, the operation must be modified or discontinued. No risk or ignition or re-ignition will exist upon leaving the operation area; • Notify the appropriate fire center immediately of the location and status of any escaped fire; • Review weather forecasts and the potential fire danger prior to any operation involving potential sources of fire ignition from vehicles, equipment, or other means. Prevention measures to be taken each workday will be included in the specific job briefing. Consideration will be given to additional mitigation measures or temporary discontinuance of the operation during periods of extreme wind and dryness; • Operate all vehicles on designated roads. Vehicle parking to be restricted to areas free of vegetation on roads or within the permitted ROW and designated work areas.;

DEIS NO.	PHASE(S)[1]	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			• Operate welding, grinding, or cutting activities in areas cleared of vegetation within range of the sparks for that particular action. A spotter will be required to watch for ignitions; and • Use only diesel-powered vehicles in areas where excessive heat from vehicle exhaust systems could start brush or grass fires.

Notes: [1] P = Planning and Engineering, C = Construction, O = Operation, D = Decommissioning

8.4 Selective Mitigation by Milepost

To be determined.

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