Amended Plan of Development for the Southline Transmission Project

Submitted to:

Bureau of Land Management and Western Area Power Administration

Submitted by:

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July 2013

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Acronyms and Abbreviations

°C	degrees Celsius
°F	degrees Fahrenheit
ADEQ	Arizona Department of Environmental Quality
AGFD	Arizona Game and Fish Department
APE	area of potential effect
APM	Applicant Proposed Measure
Applicant	Southline Transmission, L.L.C.
ATV	all-terrain vehicle
BLM	Bureau of Land Management
BMP	best management practice
CBP	U.S. Customs and Border Protection
DMP	DeMoss Petrie
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
ESA	Endangered Species Act, environmental site assessment
FAA	Federal Aviation Administration
FLPMA	Federal Land Policy and Management Act
HASP	health and safety plan
HPTP	historic properties treatment plan
Hwy 9	Highway 9
I-10	Interstate 10
kV	kilovolt
MOU	memorandum of understanding
MW	megawatt
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NRHP	National Register of Historic Places
O&M	operation and maintenance
OHV	off-highway vehicle
POD	Plan of Development
project	Southline Transmission Project
ROW	right-of-way

SF-299	Application for Transportation and Utility Systems and Facilities on Federal Lands
SF6	sulfur hexafluoride
SWPPP	stormwater pollution prevention plan
USFWS	U.S. Fish and Wildlife Service
WEAP	worker environmental awareness program
Western	Western Area Power Administration

1 INTRODUCTION

Southline Transmission, L.L.C. (Applicant) proposes to construct a high-voltage electric transmission line and associated facilities in southern New Mexico and southern Arizona (the Southline Transmission Project, or proposed project). The proposed project would cross private and public lands, including lands controlled by the Bureau of Land Management (BLM). A portion of the proposed project would involve the upgrade of existing Western Area Power Administration (Western) transmission facilities, and portions of the proposed project may involve joint ownership with Western.

The proposed project would include a New Build Section (New Build) and an Upgrade Section (Upgrade). The New Build would involve the construction of approximately 240 miles of new 345-kilovolt (kV) double-circuit electric transmission line in New Mexico and Arizona, and would have an initial rated capacity of up to 1,000 megawatts (MW). The New Build is defined by end points of the existing Afton Substation, south of Las Cruces, New Mexico, and the existing Apache Substation, south of Willcox, Arizona. The Upgrade would rebuild approximately 120 miles of existing 115-kV transmission lines and would connect to existing intermediate substations, providing up to 1,000 MW of initial rated transmission capacity between the Apache and Saguaro substations. The Upgrade would consist of double-circuit 230-kV lines connecting the Apache Substation to new Saguaro 230-kV facilities and to the existing Tortolita Substation, both located adjacent to the existing 115-kV Saguaro Substation northwest of Tucson, Arizona.

This Plan of Development (POD) was originally submitted to the BLM in 2009 and subsequently amended in December 2010, September 2011, and April 2012. The POD is being updated in support of the environmental analysis of the proposed project associated with obtaining ROW across BLM lands. The POD includes a discussion of the purpose and need for the proposed project; a summary of the detailed route selection study that resulted in selection of proposed and alternative routes; and guidelines for project design, construction, operation, and maintenance procedures. The Applicant is committed to working closely with the BLM, State agencies, private landowners, and other stakeholders throughout the environmental review process. The proposed project would be constructed and operated in conformance with the approved POD, which would be part of the ROW grant.

The project team has worked closely with local utilities and other transmission providers since 2009 to ensure the proposed project meets local needs and improves the regional transmission system. With the aim of bringing the proposed project in service in 2016, the anticipated schedule includes routing and associated public engagement and permitting through 2014, engineering beginning in 2013, and ROW acquisition and construction beginning in 2014.

1.1 Plan of Development Organization

This POD is organized as follows:

- Section 1 – Introduction
- Section 2 – Purpose, Need, and Objectives
- Section 3 – Government Agencies Involved
- Section 4 – Project Description
- Section 5 – Project Construction
- Section 6 – Maintenance and Operation
- Section 7 – Decommissioning
- Section 8 – Environmental Resources and Mitigation

2 PURPOSE, NEED, AND OBJECTIVES

The Applicant proposes to construct a high-voltage electric transmission line in southern New Mexico and Arizona (the proposed project). The proposed project would also involve related substation and communications facilities. Although it would cross some private and State-owned lands, much of the line would cross public lands controlled by the BLM. The proposed project would also cross some lands managed by the United States Forest Service and the Bureau of Reclamation. A portion of the proposed project involves upgrading existing Western transmission facilities. The Applicant and Western have executed a memorandum of understanding (MOU) to provide for the negotiation of an agreement for the joint ownership and development of transmission facilities.

2.1 Applicant's Purpose for the Proposed Action

The proposed project has been designed to improve the electric transmission infrastructure in southern New Mexico and southern Arizona in order to strengthen the existing system and to cost effectively provide up to 1,000 MW of initial bidirectional transmission capacity between southern New Mexico and southern Arizona.

The proposed project has been developed to meet the following principal needs:

- *Improve reliability in southern New Mexico and southern Arizona* - There is limited existing electrical transmission capacity in the region, which causes grid reliability risks;
- *Mitigate Existing Congestion* - Existing transmission capacity is fully utilized, and additional capacity in the region is needed to help to relieve congestion and, thereby, increase grid efficiency;
- *Increase the ability to meet demand growth in the region* - The Desert Southwest area is expected to experience substantial long-term growth, thereby creating demand for additional electric transmission capacity; and
- *Facilitate renewable generation development and public policy goals* - Satisfying the renewable portfolio standard requirements of western states will require access by renewable energy facilities to adequate electrical transmission facilities.

To meet these principal needs, the proposed project has been designed to achieve the following project-specific objectives:

a) Create a link that provides benefits to population load centers on both ends of the line by connecting the Las Cruces and El Paso areas on the eastern portion of the line with the Tucson and Phoenix areas on the western portion.

b) Provide multiple intermediate access points with proposed connections to up to 14 existing substations, whose inclusion is prioritized by technical system requirements and regional planning.

c) Provide a solution that fits with broader regional utility planning and needs. Provide for the efficient, cost-effective, and bidirectional transmission of up to 1,000 MW of initial rated capacity.

d) Utilize an innovative public-private partnership to select lines for upgrade that would create effective transmission capacity additions.

e) Maximize the use of existing ROWs and designated utility corridors in order to help minimize environmental and social impacts.

f) Meet North American Electric Reliability Corporation and Western Electricity Coordinating Council standards and guidelines.

g) Provide a path consistent with renewable resource land use efforts.

h) Develop the proposed Midpoint Substation as an additional interconnection point for renewable resources.

2.2 Agencies' Need for the Proposed Action

BLM's Purpose and Need

On December 4, 2009, and as amended on December 22, 2010, the Applicant submitted to the BLM an SF-299 *Application for Transportation and Utility Systems and Facilities on Federal Lands* that requested the BLM to grant ROW on public lands necessary to construct the Southline project. The BLM is authorized to grant ROW for electrical transmission lines under the Federal Land Policy and Management Act (FLPMA) Title V (43 U.S.C. 1761 – 1771), and pursuant to 43 C.F.R 2800 has authority to "grant, issue, or review rights-of-way for . . . transmission, and distribution of electric energy." Additionally, as part of its review of Southline's ROW application, the BLM must formulate a range of reasonable alternative routes to be considered in an Environmental Impact Statement ("EIS").

Western's Purpose and Need

Western needs to respond to a project proposed by the Applicant that would, in part, include the upgrading of two existing Western lines and use of existing Western transmission easements. In addition, the Applicant has requested consideration of their proposed project for funding under the amended Hoover Power Plant Act of 1984 (Hoover Act), as described in more detail below. As a result of the Applicant's proposal, Western needs to determine whether to allow upgrading of its existing transmission facilities, the nature and extent of its participation in the Applicant's proposed project, and whether to fund the proposed project under the Hoover Act amendments.

Western has a mandate to carry out Federal policy to facilitate renewable energy development and transmission expansion as established in the 2009 amendment of the Hoover Act (Pub. Law 98-381, Title III, § 301). The amended Hoover Act authorizes Western to borrow funds from the U.S. Treasury to construct, finance, facilitate, plan, operate, maintain, and/or study construction of new or upgraded electric power transmission lines and related facilities. These transmission lines and related facilities must have at least one terminus in Western's marketing area and deliver or facilitate the delivery of power from renewable resources constructed or reasonably expected to be constructed after the enactment of the amended Hoover Act. Projects proposed for funding under the amended Hoover Act authority are managed under Western's Transmission Infrastructure Program (TIP).

The Arizona Corporation Commission commissioned a study which identified the need to improve system reliability in southern Arizona and facilitate the delivery of substantial amounts of power from renewable energy generation projects anticipated to be developed in south central Arizona (Final Report of the Arizona Renewable Resource and Transmission Identification Subcommittee, September 2009). The Applicant's proposal to upgrade Western's existing transmission lines as part of their overall proposed Project would meet some of the needs identified in this report by strengthening the integrated transmission system, increasing transmission capacity, and improving power delivery. As part of Western's own efforts to maintain the reliability of its transmission system and meet system and customer needs, the upgrade of these two transmission lines have already been identified in Western's Desert Southwest Region's ten-year plan for construction and maintenance projects.

Western's Decisions Regarding the Southline Project

Western must decide if the Applicant can upgrade Western's existing Saguaro-Tucson and Tucson-Apache 115-kV transmission lines and use Western's existing transmission easements as part of their proposed Southline Transmission Project. If Western decides in the affirmative, Western and the Applicant would enter into a joint project agreement, and a number of contractual, ownership, technical, and engineering decisions would be required in order to accomplish the upgrade.

Western must also decide whether it would use its borrowing authority to finance the proposed Southline Transmission Project. Western would need to make decisions on the amount of committed funding, associated ownership and capacity rights and conditions, repayment provisions, and other decisions related to the nature and extent of its participation in the proposed Project. Specifically, funding would be used to construct, operate, maintain, and eventually decommission the proposed transmission line, as well as to remove the existing Western transmission lines. These decisions would be managed through contractual agreements that would include defining the respective rights and obligations associated with ownership of the Project; address construction, operation, and maintenance associated with the transmission line; and provide for acquisition of ROWs for the Project.

Prior to committing funds for construction, Western must certify that a project is in the public interest; 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 from Treasury. In addition, the Project would need to satisfy the requirements of Western's TIP and its authority under the Hoover Act. Western's decision would be partially informed by the required NEPA analysis and disclosure in the EIS being developed for this Project.

Alternatively, Western could choose to participate in the project without using borrowing authority. This decision would be a reliability and maintenance decision based on the existing need to upgrade the aging Tucson-Apache and Saguaro-Tucson 115-kV transmission lines. These transmission lines have been identified for upgrade in Western's ten-year construction and maintenance plan based on age, condition, loading, and future growth scenarios. In this case, funding of the upgrades would be recovered through power rates charged to Western power customers.

3 GOVERNMENT AGENCIES INVOLVED

The BLM and Western have agreed to be co-lead, or Joint Lead, agencies under the National Environmental Policy Act (NEPA) for development of the EIS for the proposed project. Additionally, Western, a power marketing administration of DOE, has executed an MOU with the Applicant representing both parties' intent to move forward with the detailed evaluation and consideration of the proposed project. The Applicant has also filed a statement of interest with Western's Transmission Infrastructure Program and anticipates working closely with Western to define roles and responsibilities and to evaluate potential project business and construction plans, including joint ownership possibilities. This may include Western's acquisition of ROWs necessary for portions of the proposed project.

Alternatives for the proposed transmission line would also cross private, State, and Federal lands in New Mexico and Arizona. State and local agencies and recognized Native American tribes may have jurisdiction over lands that could be affected by the proposed project. Accordingly, these agencies and tribes would be invited to participate in the evaluation of the proposed project as appropriate.

4 PROJECT DESCRIPTION

4.1 Applicant Proposed Route

The proposed route and alternatives are summarized in figures 4-1 through 4-3. Please see the Routing Report for more information.

FIGURE 4-1: PROPOSED AND ALTERNATIVE ROUTES

FIGURE 4-2: PROPOSED AND ALTERNATIVE ROUTES, NEW BUILD SECTION

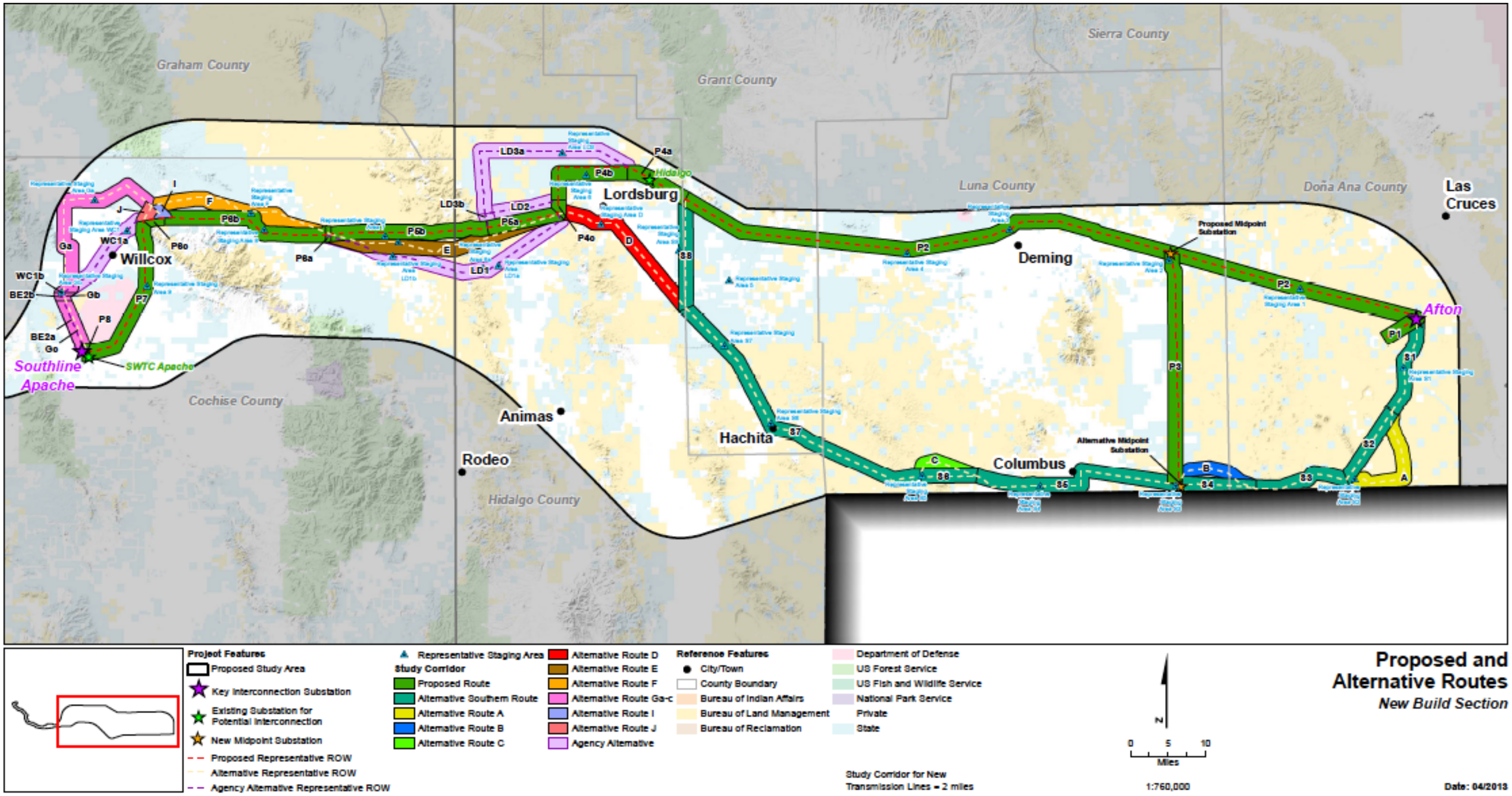
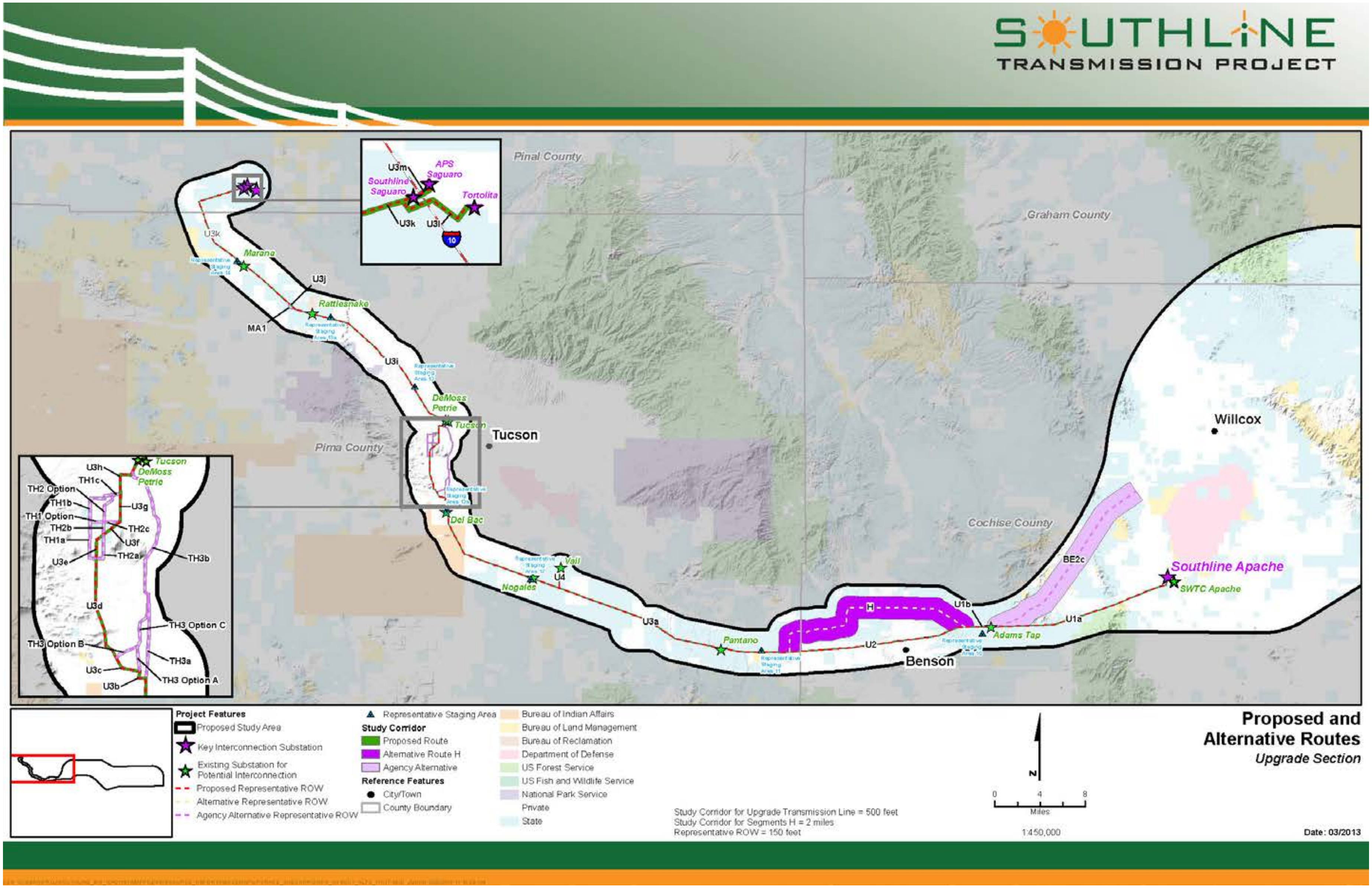


FIGURE 4-3: PROPOSED AND ALTERNATIVE ROUTES, UPGRADE SECTION



4.1.1 Proposed New Build Section (Afton Substation to Apache Substation)

The proposed New Build Section would begin at the Afton Substation and follow an existing 345-kV transmission line northwest to I-10 (see figure 4-2), past the Aden Hills off-highway vehicle (OHV) area. From there, the proposed route would cross I-10 just past Doña, and continue north of I-10 to Carne. Approaching Deming from the east, the route would run north of Deming and then follow existing roads west. The route would head northwest to the Hidalgo Substation. From the Hidalgo Substation, the route would continue due west, north around Lordsburg, and south to follow an existing pipeline ROW. The proposed project route would then cross I-10 west of San Simon and follow an existing pipeline route south of the highway and north of the Dos Cabezas Peaks Area of Critical Environmental Concern. The route would then turn south (east of the Town of Willcox) and along existing transmission facilities, east of the Willcox Playa, to the Apache Substation. The termination point at the Apache Substation would be the western extent of the proposed project's New Build Section. The total length of the transmission line using the proposed northern route from the Afton Substation to the Apache Substation would be approximately 205 miles.

The proposed project would also include an approximately 30-mile segment between Highway 9 and I-10 in New Mexico, referred to as Segment P3. This segment could be used as a connector between the northern and southern primary routes but is primarily envisioned as a way to provide interconnection for potential solar generation that could be developed along this segment (no specific generation projects have been identified at this time). The proposed Midpoint Substation would interconnect Segment P3 to the Southline Transmission Project and would be built when needed to connect generation proposed along Segment P3.

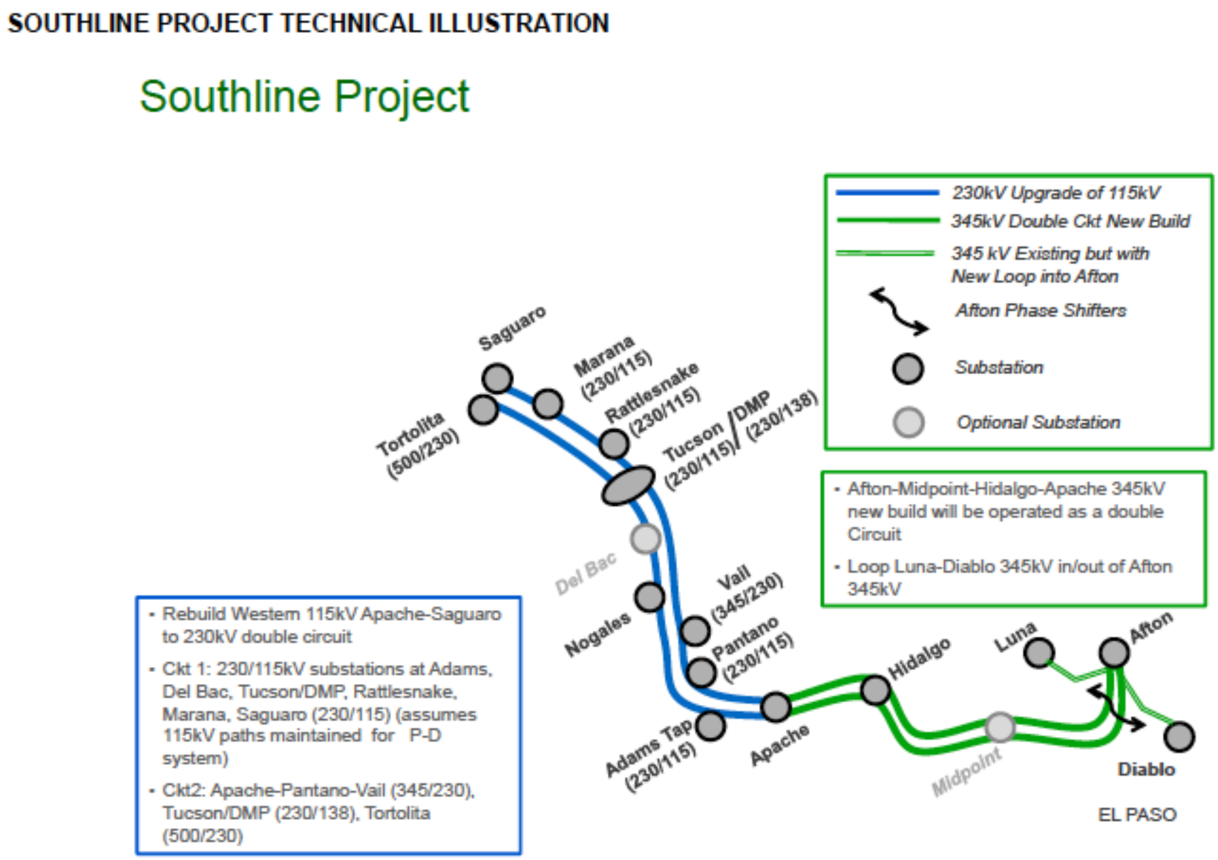
The proposed project would also include a 5-mile in-and-out loop between the existing Afton Substation and the existing Luna-Diablo 345-kV transmission line. The in-and-out loop of the Luna-Diablo line into the Afton Substation is a technical requirement of the proposed project and serves to strengthen the existing system.

Total New Build length, including all proposed segments, is approximately 240 miles.

4.1.2 Proposed Upgrade Section (Apache to Saguaro)

The Upgrade Section would start at the Apache Substation and terminate at the Saguaro and Tortolita substations (see figure 4-3). This section of the proposed project is an upgrade of the existing Western 115-kV transmission line through Cochise, Pima, and Pinal counties. The Applicant anticipates replacing the existing 115-kV line with a double-circuit 230-kV line in its current location, following the same path as the existing transmission line. A new line segment approximately 2 miles in length would be required to interconnect with the existing Tucson Electric Power Vail Substation, located just north of the Western line. The Upgrade Section is approximately 120 miles in length and would interconnect with up to 14 substations along the route. See figure 4-4 for a technical sketch of the New Build Section and Upgrade Section.

FIGURE 4-4: SOUTHLINE TRANSMISSION PROJECT TECHNICAL SKETCH



4.2 Project Facilities

The proposed project would be designed, constructed, operated, and maintained in accordance with applicable standards and criteria, and would meet or exceed the standards set forth in the National Electrical Safety Code.

The Proposed project would consist of a transmission line designed to collect and transmit electricity across southern New Mexico and southern Arizona and would consist of the following components:

- Proposed New Build Section (Afton to Apache):
  - A new 205-mile, 345-kV double-circuit transmission line, crossing both public and private lands, between the existing Afton Substation, located in Doña Ana County in southeastern New Mexico, and the Apache Substation, located in Cochise County in southeastern Arizona.
  - An approximately 30-mile 345-kV segment between Highway 9 (Hwy 9) and Interstate 10 (I-10) in Luna County, New Mexico.
  - A 5-mile 345-kV in-and-out loop between the existing Afton Substation and the existing Luna-Diablo 345-kV transmission line.
- Proposed Upgrade Section (Apache Substation to Saguaro Substation):
  - An upgrade of approximately 120 miles of existing 115-kV single-circuit transmission line between the existing Apache and Saguaro substations in Pinal County, Arizona, to a double-circuit 230-kV transmission line.
  - The 120-mile total includes a new, approximately 2-mile line 230-kV double-circuit segment between the Western Upgrade portion of the proposed project and the Vail Substation. It also includes a new,

approximately 0.2 mile 138-kV double-circuit segment between the existing Tucson Substation and the existing DMP Substation, generally paralleling the 230-kV segment. The structure details for the 138-kV segment would be similar to those for the 230 kV segments.

- Interconnections with and potential upgrades of up to 14 existing substations along the proposed project route.
- Depending on the ultimately selected route, possible development of a new substation within the study area in Luna County, New Mexico.
- Telecommunications facilities for operating the substations; new access roads and spur roads for accessing the structures along the new and upgraded portions of the line; and staging and material storage areas.
- The project structures would also carry fiber optic communications lines.

4.2.1 345-kV Transmission Line Characteristics and Design

The information presented in this section is preliminary and subject to change as the design process is further refined.

TABLE 4-1: TRANSMISSION LINE CHARACTERISTICS AND DESIGN (345 KV)

345-kV Transmission Line Characteristics

Feature	Description
Physical Properties	
Line Length	Approximately 240 miles as proposed
Type of Structure	Proposed Structure Type – Self-supporting lattice towers Alternative Structure Type – Tubular steel structures
Structure Height	Lattice towers – 110 to 170 feet Tubular steel structures – 90 to 150 feet
Span Length	Lattice towers – 1,000 to 1,400 feet Tubular steel structures – 800 to 1,100 feet
Number of Structures per Mile	4 to 8 depending on structure type, terrain, and other factors.
ROW Width	200 feet. Increased ROW width may be required in a small number of site-specific locations to accommodate rough terrain or unusually long spans.
Land Temporarily Disturbed	
Structure Work Area	100 feet by 200 feet per structure for assembly, erection, and crane pads. This work area may be larger or smaller depending on specific structure sizes and ground topography.
Wire Pulling and Tensioning Sites	200 feet by 550 feet at all dead-end structures and heavy angle structures with greater than 25° line angles. 200 feet by 500 feet for mid-span conductor and shield wire setup sites (approximately every 10,000 feet). 100 feet width by 500 feet for fiber optic cable setup sites (approximately every 18,000 feet).
Wire Splicing Sites	ROW width by 500 feet per conductor and shield wire setup site (approximately every 9,000 feet). ROW width by 500 feet each for fiber optic cable setup site (approximately every 18,000 feet).
Staging Areas	At approximately 20- to 25-mile intervals. [8 to 12] total locations expected. Typical staging areas approximately 10 to 20 acres.
Batch Plant Sites	8 to 12 batch plant sites, most located at staging areas. Stand-alone temporary batch plants, each totaling approximately 3 to 5 acres.
Guard Structures	100 by 100 feet at road and existing electrical line crossings.

Land Permanently Required	
Structure Base	Lattice tower (tangent) – 1,225 square feet (35 by 35 feet tower base) Lattice tower (angle) – 1,600 square feet (40 by 40 feet tower base) Lattice tower (dead-end) – 2,025 square feet (45 by 45 tower base feet) Single-pole tubular steel structure (tangent) - 40 square feet (7-foot-diameter foundation) Single-pole tubular steel structure (dead-end/angle) - 100 square feet (2 poles x 8-foot-diameter foundation
Regeneration Sites	1 to 3 regeneration sites, most located on the transmission line ROW, each totaling approximately 10,000 square feet (100 by 100 feet).
Access Roads	
Paved Roads	These roads are typically highways and State routes, and would be used for travel to existing and new dirt roads to access the ROW.
Dirt/Gravel Roads (no improvement)	These roads require no improvement.
Dirt/Gravel Roads (with improvements)	Improvement of existing dirt roads (typically 12-16 feet wide) up to maximum width of 20 feet.
New Access Road (bladed)	Roads, graded to a width of 12-16 feet with a 2-foot berm on either side.
Overland Access	Drive and crush, typically 10-14 feet wide up to a maximum width of 18 feet.
Electrical Properties	
Nominal Voltage	345,000 volts
Capacity	Up to 2,000 MW ultimate capacity and 1,000 MW initial capacity.
Circuit Configuration	Double-circuit
Conductor Size	To be determined. Size anticipated to be approximately 1,272 kcmil ACSR, with two subconductors per phase.
Ground Clearance of Conductor	30 feet minimum at a conductor temperature of 212 degrees Fahrenheit (°F) (100 degrees Celsius [°C]).
Lightning Shielding Conductor Size	To be determined based on strike data for the area, but anticipated to be 7/16” EHS steel wire. One or both of the shield wires would be of the OPGW type (approximately ½” in diameter) and include fiber optic communication capability for use in substation communication and protective relaying.

The 345-kV double-circuit conductors may be supported by lattice towers or tubular steel structures. Appendix I, *Typical Transmission Structure Diagrams*, includes concept diagrams of the proposed structure types. The final decision to use a specific type of structure would be based on structural requirements as well as economic and visual considerations. The lattice towers are anticipated to be constructed of galvanized steel with a height ranging from 110 to 170 feet, a width at the base of approximately 25 feet, and a width at the top of 35 to 50 feet. The distance between each tower would depend on site-specific characteristics but is expected to be approximately 1,200 feet. Each tower would have four legs, each set on concrete foundations placed in the ground. The expected permanent disturbed area per tower is approximately 100 square feet. Tubular steel structures are expected to range from 90 to 150 feet, with an approximate 900-foot span. Tubular steel structures would either be direct-embedded or would be set on a concrete foundation placed in the ground. The expected permanent disturbed area per pole structure would vary from 20 square feet for the smallest anticipated direct-embedded pole to 113 square feet for the largest pole on a concrete foundation. It is assumed that concrete foundations would be of the drilled pier type, with detailed design to be completed once site-specific soil conditions can be evaluated.

It is anticipated that a bundle of two subconductors per phase would be used. The subconductors are typically spaced approximately 18 inches apart in either a vertical or horizontal configuration. The configuration of the bundle would be designed to provide adequate current-carrying capacity while minimizing interference from audible noise and to radio operations. Insulator assemblies may consist of single strings or two strings of insulators, sometimes in the form of a “V.” These strings are used to suspend each conductor bundle from the structure, maintaining the appropriate electrical clearance between the conductor, the ground, and the structure. Lightning shielding would be accomplished through the use of overhead shield wires strung between each tower.

One or both of these shield wires would be of the OPGW type and include fiber optic communication capability for use in substation communication and protective relaying.

In addition to the conductors, insulator, and overhead shield wires, other associated hardware would be installed on the tower as part of the insulator assembly to support the conductors and shield wires. This hardware might include clamps, shackles, links, plates, and various other pieces composed of steel and aluminum. Additionally, a grounding system would be installed at the base of each transmission structure that would consist of copper or copperweld ground rods embedded into the ground in immediate proximity to the structure foundation and connected to the structure by buried copper or other suitable conductor.

Vibration dampers would be used to help control Aeolian vibration. The type and number of dampers required would be determined during detail design after consultation with the suppliers. It is anticipated that each conductor span would have two stockbridge dampers per wire and that each shield wire/OPGW span would have four spiral dampers per wire.

Aerial marker spheres or aircraft warning lighting may be required for the conductors or structures in accordance with Federal Aviation Administration (FAA), U.S. Customs and Border Protection (CBP), or U.S. Department of Defense (DoD) regulations. Structure height and proximity to airports are the determinants of whether FAA regulations would apply. It should be noted that the proposed route is not expected to be close enough in proximity to impact operations at any commercial airports.

4.2.2 230-kV Transmission Line Characteristics and Design

The information presented in this section is preliminary and subject to change as the design process is further refined.

TABLE 4-2: TRANSMISSION LINE CHARACTERISTICS AND DESIGN (230 KV)

230-kV Transmission Line Characteristics

Feature	Description
Physical Properties	
Line Length	Approximately 120 miles
Type of Structure	Tubular steel structures
Structure Height	100 to 140 feet
Span Length	Tubular steel structures – 700 to 1,100 feet
Number of Structures per Mile	5 to 8 depending on structure type, terrain and other factors.
ROW Width	150 feet. Increased ROW width may be required in a small number of site-specific locations to accommodate rough terrain or unusually long spans.
Land Temporarily Disturbed	
Structure Work Area	100 feet by 200 feet per structure for erection and crane pads.
Wire Pulling and Tensioning Sites	150 feet by 500 feet at all dead-end structures and heavy angle structures with greater than 25° line angles.

TABLE 4-2: TRANSMISSION LINE CHARACTERISTICS AND DESIGN (230 KV)

	150 feet by 450 feet for mid-span conductor and shield wire setup sites (approximately every 10,000 feet). 100 feet width by 450 feet for fiber optic cable setup sites (approximately every 18,000 feet).
Wire Splicing Sites	ROW width by 450 feet per conductor and shield wire setup site (approximately every 9,000 feet). Row width by 450 feet each for fiber optic cable setup site (approximately every 18,000 feet).
Staging Areas	At approximately 20- to 25-mile intervals. 5 to 7 total locations expected. Typical staging areas each totaling approximately 10 to 15 acres.
Batch Plant Sites	3 to 5 batch plant sites, most located at staging areas. Stand-alone temporary batch plants, each totaling approximately 3 to 5 acres.
Guard Structures	100 by 100 feet at road and existing electrical line crossings.
Land Permanently Required	
Structure Base	Single-pole tubular steel structure (tangent) – 40 square feet (7-foot-diameter foundation) Single-pole tubular steel structure (dead-end/angle) – 50 square feet (8-foot-diameter foundation)
Regeneration Sites	Not required.
Access Roads	
Paved Roads	These roads are typically highways and State routes, and would be used for travel to existing and new dirt roads to access the ROW.
Dirt/Gravel Roads (no improvement)	These roads require no improvement.
Dirt/Gravel Roads (with improvements)	Improvement of existing dirt roads (typically 12-16 feet wide) up to maximum width of 20 feet.
New Access Road (bladed)	Roads, graded to a width of 12-16 feet with a 2-foot berm on either side.
Overland Access	Drive and crush, typically 10-14 feet wide up to a maximum width of 18 feet.
Electrical Properties	
Nominal Voltage	230,000 volts
Capacity	Up to 1,500 MW ultimate capacity and 1,000 MW initial capacity
Circuit Configuration	Double Circuit
Conductor Size	To be determined. Size anticipated to be 1,272 ACSS, with one subconductor per phase.
Ground Clearance of Conductor	28 feet minimum at a conductor temperature of 212 °F (100 °C).
Lightning Shield Conductor Size	To be determined based on strike data for the area, but anticipated to be either 3/8” HS or 7/16” EHS steel wire. One or both of the shield wires would be of the OPGW type (approximately ½” in diameter) and include fiber optic communication capability for use in substation communication and protective relaying.

The 230-kV double-circuit conductors are expected to be supported by tubular steel structures. Appendix I, *Typical Transmission Structure Diagrams*, includes concept diagrams of the proposed structure types. The tubular steel structures are anticipated to be constructed of galvanized or self-weathering steel with a height ranging from 100 to 140 feet. The distance between each structure would depend on site-specific characteristics but is expected to be approximately 900 feet. Each tubular steel structure would be either directly embedded or foundation mounted in concrete. Where foundations are necessary, it is assumed that they would be of the drilled pier type, with detailed design to be completed once site-specific conditions can be evaluated. The expected permanent disturbed area per structure would vary from 13 square feet for the smallest anticipated direct-embedded tubular steel structure to 80 square feet for the largest tubular steel structure on a concrete foundation.

It is anticipated that one conductor per phase would be used. The conductor would be sized to provide adequate current-carrying capacity while minimizing interference from audible noise and to radio operations. Insulator assemblies may consist of suspension strings or braced post insulators. These assemblies are used to suspend each conductor from the structure, maintaining the appropriate electrical clearance between the conductor, the ground, and the structure. Lightning shielding would be accomplished through the use of overhead shield wires strung between each tower. One or both of these shield wires would be of the OPGW type and include fiber optic communication capability for use in substation communication and protective relaying.

In addition to the conductors, insulators, and overhead shield wires, other associated hardware would be installed on the pole as part of the insulator assembly to support the conductors and shield wires. This hardware might include clamps, shackles, links, plates, and various other pieces composed of steel and aluminum. Additionally, a grounding system would be installed at the base of each transmission structure that would consist of copper or copperweld ground rods embedded into the ground in immediate proximity to the structure foundation and connected to the structure by buried copper or other suitable conductor.

Vibration dampers would be used to help control Aeolian vibration. The type and number of dampers required would be determined during detail design after consultation with the suppliers. It is anticipated that each conductor span would have one stockbridge damper per wire and that each shield wire/OPGW span would have two spiral dampers per wire.

Aerial marker spheres or aircraft warning lighting may be required for the conductors or structures in accordance with FAA, CBP, or DoD regulations. Structure height and proximity to airports are the determinants of whether FAA regulations would apply. In particular, the FAA will be contacted regarding any height restrictions within the glide path of the Tucson International Airport NE-SW runway. The proposed centerline is approximately 6700 feet from the end of that runway.

4.2.3 Substations

The proposed project would connect to up to 14 existing substation locations and one new substation location. Each substation location would require upgraded or new facilities. Some facilities will be inside existing yards, some will require replacement or expansion of existing yards, and some will require new yards adjacent or in close proximity to existing yards at these existing substation locations. Representative expansion areas have been identified for environmental impact analysis and will be further refined in detailed engineering.

Below are descriptions of the planned scope at each of the affected substations. Appendix H, *Substation Equipment Breakdown*, includes a detailed breakdown of all the major equipment that would be required to facilitate these expansions and additions. This breakdown is based on the current requirements defined by the ongoing system studies as well as the preliminary substation layouts. The quantities are subject to change as detailed design progresses for the project.

Substations on or Adjacent to BLM lands

There are three substations that may require BLM ROW grants. Those substations include: 1) the existing Afton Substation in New Mexico; 2) a potential newly constructed station in Luna County, New Mexico (referred to as Midpoint Substation below); and 3) the Nogales Substation in Arizona. Appendix G, *Substation Disturbance Estimates*, includes disturbance assumptions used in the development of the resource reports.

Substations Related to the New Build Section

4.2.3.1.1 Afton Substation

The Afton Substation is an existing 345-kV station owned and operated by El Paso Electric. Additional land would be required for a new yard and for temporary transmission line construction and substation staging area. Existing main buses would be expanded to accommodate two additional bays. A new yard would be built adjacent to the existing switchyard on the west side, and would accommodate two phase-shifting transformers, line series capacitors, and shunt reactors. Two lines from Midpoint Substation would be terminated in the existing switchyard. In addition, the Luna - Diablo line would be looped into the new yard taking up the other two positions. The maximum takeoff tower height would be approximately 80 feet.

4.2.3.1.2 Midpoint Substation

A new 345-kV Midpoint Substation may be located between the Afton and Hidalgo substations. Five to six transmission lines would be terminated at that the Midpoint Substation. The yard would accommodate two bays initially for four line positions but would have enough room to ultimately expand to four bays or eight line positions. The maximum takeoff tower height would be approximately 80 feet. Line series capacitors and shunt reactors would be required and would be located in the new yard.

4.2.3.1.3 Hidalgo Substation

The Hidalgo Substation is an existing 345-kV station owned and operated by El Paso Electric. The existing ring bus would be expanded to accommodate one additional line position. A tie breaker connecting the existing yard to the new yard would also be located in the existing station. The new yard would be built adjacent to the existing switchyard on the south side. The yard would accommodate two bays initially for four line positions but would have enough room to ultimately expand to four bays or eight line positions. The tie to the existing Hidalgo Substation would come off of one of the main busses and would not take up a line position. Transmission lines from Midpoint Substation and the Apache Substation would be terminated at the Hidalgo Substation. The maximum takeoff tower height would be approximately 80 feet. Line series capacitors and shunt reactors would be required as well as bus shunt capacitors; this equipment would be located in the new yard.

4.2.3.1.4 Apache Substation

The SWTC Apache Substation is an existing station owned and operated by SWTC. The existing 230-kV yard is constrained for growth. A new 345-/230-kV yard, referred to herein as the proposed Southline Apache Substation, would be built to the northwest of the existing plant and switchyard. The 345-kV portion of the proposed Southline Apache Substation would accommodate two bays initially for four positions but would have enough room to expand to four bays or eight line positions ultimately. Two 345-kV lines from Hidalgo Substation would be terminated initially. In addition, two transformer positions would be installed. Line series capacitors and shunt reactors would be required as well as bus shunt reactors and an SVC.

The 230-kV portion of the proposed Southline Apache Substation would consist of two transformer positions, three line positions, and two 345-kV/230-kV transformers. The maximum takeoff tower height would be approximately 80 feet. Two of the three line positions would be used to terminate the proposed 230-kV Upgrade Section. One circuit would continue on to the Adams Tap Substation and one circuit would continue on to the Pantano Substation. The third line position would be used to terminate a short interconnection tie to the existing SWTC Apache Substation.

The existing SWTC Apache Substation would be modified by moving the Winchester line down one bay and building out the equipment in that new location. The interconnection tie to the proposed Southline Apache Substation would then be routed into the bay vacated by the Winchester line.

Substations Related to the Upgrade of the Existing Western Facilities from Apache to Saguaro

In addition to the proposed Southline Apache Substation, several other substations would be associated with the upgrade of the existing Western facilities route. These substations would not be located on BLM land, but are identified to provide a complete description for the proposed project. Appendix G, *Substation Disturbance Estimates*, includes disturbance assumptions used in the development of the resource reports.

4.2.3.1.5 Adams Tap Substation

The Adams Tap Substation is an existing 115-kV station owned and operated by Western. The new yard would be built adjacent to the existing switchyard, and would accommodate 230-kV line positions from the Apache and Nogales substations. In addition, one transformer position would be installed. A 230-/115-kV transformer would be installed in the new yard. The low side of the transformer would be tied to an existing facility. The maximum takeoff tower height would be approximately 60 feet.

4.2.3.1.6 Pantano Substation

The existing Pantano Substation is owned and operated by SWTC. However, the Pantano Substation could not easily be expanded to accommodate additional 230-kV line positions from the Apache and Vail substations. As a result, it is anticipated that a new 230-kV station would be built close to the existing station that would consist of two bays for four line positions but would have enough room to expand to four bays or eight line positions ultimately. New 230-kV lines from Apache and Vail substations would be routed into this substation. This station would also loop in the existing SWTC 230-kV line from Apache to Bicknell. Another potential option involves adding an additional 230-/115-kV transformer position and transformer to feed SWTC's existing 115-kV line to Kartchner Substation. This option would enable the existing substation to be decommissioned.

4.2.3.1.7 Vail Substation

The Vail Substation is an existing station owned and operated by TEP. Existing bays 5 and 6 in the 345-kV yard would be built out to allow connection of the high sides of two new 345-/230-kV transformers. These transformers would be located inside the existing yard although a small addition would need to be made to the yard on the southern side. A new 230-kV yard would be built to accommodate 230-kV line positions from the Pantano and Tucson substations as well as the low side connections from the transformers. The new 230-kV yard would accommodate two bays initially for two line positions and two transformer positions but would have enough room to expand to four bays or eight line positions ultimately. The maximum takeoff tower height would be approximately 80 feet.

4.2.3.1.8 Nogales Substation

The Nogales Substation is an existing station owned and operated by Western. If commercially warranted, a new yard would be built that would accommodate 230-kV line positions from the Adams Tap and Del Bac substations. In addition, one 230-/138-kV transformer position would be installed. The low side of the transformer would be tied to the existing facility. The new 230-kV yard would accommodate two bays initially for two line positions and one transformer position but would have enough room to expand to four bays or eight positions ultimately and would be built adjacent to the existing substation. The maximum takeoff tower height would be approximately 60 feet. Two bus shunt capacitors would be required. The equipment would be located in the new yard. If the Tucson Electric Power Vail to Valencia 138-kV conversion project is completed, there may not be a need for the Nogales Substation expansion, as the current service from Nogales could be provided from the Vail Substation.

4.2.3.1.9 Del Bac Substation

The Del Bac Substation is an existing station owned and operated by Western, and is an optional stop for the proposed project. A new 230-kV substation would be built adjacent to the existing station. The new 230-kV yard would accommodate two bays initially for two line positions but would have enough room to expand to four bays or eight line positions ultimately. The maximum takeoff tower height would be approximately 60 feet.

4.2.3.1.10 Tucson Substation

The Tucson Substation is an existing facility owned and operated by Western. A new 230-kV yard would be built inside the existing yard area to accommodate four bays initially for four line positions and three transformer positions but would have enough room to expand to eight line positions ultimately. The line positions would be used for circuits to the Vail, Del Bac, Rattlesnake, and Tortolita substations. The maximum takeoff tower height would be approximately 60 feet. Three transformer positions would be installed, including one 230-/115-kV transformer position and two 230-/138-kV transformer positions. Three transformers would be located within the existing fence lines and the low side of the transformers would be tied to the existing 115-kV bus at Tucson and to the 138-kV bus at the DeMoss Petrie (DMP) Substation.

4.2.3.1.11 DeMoss Petrie Substation

The DMP Substation is an existing station owned and operated by TEP. The existing 138-kV ring buses would be expanded for two additional 138-kV line positions. The line positions would be used for circuits to the Tucson Substation.

4.2.3.1.12 Rattlesnake Substation

The Rattlesnake Substation is an existing station owned and operated by Western. A new 230-kV yard would be built to accommodate 230-kV line positions from the Tucson and Marana substations. In addition, one 230-/115-kV transformer position would be installed. The low side of the transformer would be tied to the existing facility. The new 230-kV yard would accommodate two bays initially for two line positions and one transformer position but would have enough room to expand to four bays or eight positions ultimately and would be built adjacent to the existing substation. The maximum takeoff tower height would be approximately 60 feet.

4.2.3.1.13 Marana Substation

The Marana Substation is an existing station owned and operated by SWTC. A new 230-kV yard would accommodate 230-kV line positions from the Rattlesnake and Saguaro substations. In addition, one 230-/115-kV transformer position would be installed. The low side of the transformer would be tied to the existing facility. The new 230-kV yard would accommodate two bays initially for two line positions and one transformer position but would have enough room to expand to four bays or eight positions ultimately and would be built adjacent to the existing substation. The possible need for a second 230-/115-kV transformer at this station is currently being studied but is not anticipated at this time. The maximum takeoff tower height would be approximately 60 feet.

4.2.3.1.14 Saguaro Substation

The APS Saguaro Substation is an existing station owned and operated by APS. The existing 115-kV yard is constrained for growth. A new 230-/115-kV substation, referred to herein as the proposed Southline Saguaro Substation, would be built to the west across the highway from the existing station. The new 230-kV Southline Saguaro yard would accommodate two bays initially for one line position and two transformer positions but would have enough room to expand to four bays or eight positions ultimately. The line position would be used to terminate the circuit from Marana Substation, while the second circuit from the proposed Upgrade Section would bypass this substation. The new Southline Saguaro 115-kV yard would be a five-position ring bus that would accommodate two transformer positions and three line positions. One line position would be taken by Western's ED5 115-kV transmission line, which would be relocated to terminate at the Southline Saguaro Substation instead of at the existing APS Saguaro Substation. The other two positions would be tied to the existing APS Saguaro Substation east and west 115-kV buses. The maximum takeoff tower height would be approximately 60 feet.

Two short segments of existing 115-kV transmission line right-of-way would be used to tie the Southline Saguaro Substation to the APS Saguaro Substation. These line segments currently exist as the final spans on Western's existing ED5 line and on Western's existing 115 kV line that the proposed project would upgrade between the Apache Substation and the Southline Saguaro Substation. The existing structures and wires would be reused to the extent possible. The final decision on any required modifications will be made during detailed design.

4.2.3.1.15 Tortolita Substation

The Tortolita Substation is an existing station owned and operated by TEP. A single circuit 230-kV line from Tucson Substation would be installed at the Tortolita Substation and would terminate into the low side of a new 500-/230-kV transformer. The high side of this transformer would terminate into a new position in the existing 500-kV yard. The maximum takeoff tower height would be approximately 100 feet.

4.2.4 Fiber Optic Communications and Regeneration Stations

The proposed project would include a communications system consisting of a fiber optic network necessary for control and protection of the transmission system (referred to as supervisory control and data acquisition). The fiber optic network would require regeneration stations at periodic distances along the transmission line, as determined in the detailed engineering studies. In general, these regeneration stations would be within the transmission line ROW. The Applicant may also contract with third parties for the sale and use of excess fiber optic capacity. No additional facilities are anticipated for third party-use of excess fiber optic capacity.

Primary communications for relaying and control would be provided via the one optical ground wire that would be installed in the shield wire position on the transmission line. As the optical data signal is passed through the optical fiber cable, the signal degrades with distance. Consequently, signal regeneration stations are required to amplify the signals if the distance between substations or regeneration sites exceeds approximately 50 miles.

In most cases, land for a regeneration site must be obtained along the final transmission line route. These regeneration sites are typically 100 feet by 100 feet, with a fenced-in area of 75 feet by 75 feet. A 12-foot by 32-foot by 9-foot-tall building (metal or concrete) would be placed on the site, and access roads to the site and power from the local electric distribution circuits would be required. An emergency generator with a liquid propane gas fuel tank would be installed at the site inside the fenced area. It is anticipated the emergency generators would operate about twice a year. The regeneration stations would also provide communications support for transmission line patrol and maintenance operations, and allow emergency operations independent of commercial common carrier.

For redundancy purposes, a secondary communications path would be provided via a power line carrier system or a microwave system, which may require microwave regeneration stations for the proposed project. The number, location, and typical design and layout of microwave sites would be determined as project engineering progresses. A typical microwave station consists of a microwave equipment building, which houses telecommunication and network equipment, backup batteries, and chargers. The station also has a microwave antenna, which typically is installed on a self-standing tower. Additional antennae may be added to existing towers where practical.

Microwave regeneration sites are anticipated to be 100' X 100' and would occur when a line segment is greater in length than 50 miles. Two microwave regeneration sites are anticipated for the New Build Section, one on the Apache-Hidalgo segment and one on the Hidalgo-Midpoint segment. Microwave regeneration sites are not anticipated to be needed on the Upgrade Section. Microwave regeneration sites would be located during the detailed design phase based on line of sight between the substations.

4.2.5 Access Roads

Surface access roads would be required in order to reach each transmission line tower, each substation, each regeneration station, and each new microwave site. The proposed project would use existing access roads where possible. In some cases, the existing roads would require improvement. Such improvements could include blading, widening of the road, or installing drainage structures, such as culverts. Where new access roads are required, they would be approximately 12-16 feet wide in straight areas and 16-20 feet wide at turns. Please see Appendix D, *Access Roads – Characterization and Disturbance Estimates* for further Access Road information.

4.2.6 Temporary Work Areas

During construction, there would be requirements for temporary workspace, including wire splicing and pulling sites, and staging areas. The temporary workspace would include an area approximately 200 feet by 100 feet around each tower location. Wire pulling and tensioning sites would be located along the ROW at intervals determined by site-specific conditions. Tensioning sites are anticipated to be located approximately 10,000 feet apart. Staging areas would usually be located adjacent to the ROW and would occupy approximately 10 to 20 acres per site. Staging areas are expected to be spaced at approximately 20- to 25-mile intervals and would be used for trailers, parking, and material staging. They may also be used for partial structure assembly and concrete batch plants. Please see Appendix C, *Staging Areas* for further Staging Area information.

4.2.7 Potentially Required System Modifications—Network Upgrades

The implementation of the proposed project could require upgrades to the existing electrical system to maintain system performance and system reliability and to achieve the project's proposed path rating. The proposed project is currently undergoing the WECC path rating process during which a Project Review Group will be evaluating technical studies to determine what, if any, system modifications or upgrades might be needed.

Specific potential system improvements are not well defined at this time, but it is expected that the current studies may identify the potential need to add, replace or modify equipment within existing substation locations. Some of the modifications anticipated may require work outside the existing fence (i.e. fence expansions, structure moves). Further information will be available following advancement of WECC path rating studies and further detailed engineering.

5 PROJECT CONSTRUCTION

5.1 Preconstruction Activities

The Applicant intends to refine the design of the proposed project during the Federal and State approval processes. Final engineering surveys would determine the exact locations of towers, access roads, etc., prior to construction. Technical and power system studies would determine items such as conductor sizes, substation arrangements, communication needs, and similar issues. Due to the broad scope of construction, the varied nature of construction activities, and the geographic diversity of the proposed project area, the Applicant envisions that multiple construction spreads, or work areas, would be active simultaneously in different areas to complete project work within the projected timeframe and in accordance with industry performance standards.

The Applicant proposes to acquire a permanent 200-foot-wide ROW for construction and operation of the 345-kV line and a 150-foot-wide ROW for the 230-kV line. This ROW has been designed to allow for the safe movement and operation of construction equipment, the safe construction of the proposed project facilities, and to allow for sufficient clearance between conductors and the ROW edge as required by the NESC.

Preconstruction activities, including preconstruction environmental surveys, materials procurement, design, contracting, ROW acquisition, and permitting efforts, would all influence project schedule. The schedule is predicated upon completion of the following tasks in a timely manner:

- Securing all necessary permit approvals;
- Completing biological and cultural survey work;
- Completing final engineering surveys;
- Construction within environmental time constraints;
- Ordering and receiving equipment;
- Securing construction contractor resources and associated construction equipment; and
- Maintaining continuous construction activity with no delays.

The Applicant would obtain a ROW through a combination of ROW grants and easements negotiated between the Applicant and various Federal, State, and local governments; private companies; and private landowners. During the early stages of the proposed project, the Applicant would coordinate with property owners and land agencies to obtain right-of-entry permissions for surveys and geotechnical drilling at selected locations.

5.2 Construction Workforce and Schedule

The anticipated operational (in-service) date for the proposed project is 2016. Construction activities are expected to occur over a 24-month period, starting in 2014. Work would commence upon receipt of all necessary permits and ROW grants.

5.2.1 Transmission Line Construction Workforce (345 kV)

The estimated number of workers and types of equipment necessary to construct the proposed 345-kV transmission line are shown in Table 5-1. Additional equipment may be required on an as-needed basis to mobilize, maintain, and demobilize the other equipment.

TABLE 5-1: ANTICIPATED CONSTRUCTION WORK FORCE AND EQUIPMENT (345 KV)

Activity	Equipment		Crew
Project Administration	5 pickup trucks		15
ROW Survey	1 helicopter 2 all-terrain vehicles (ATVs)	2 pickup trucks	8
Geotechnical Investigations	1 (2-ton) drill truck	1 pickup truck	3
Access Road Construction	2 bulldozers (D-6 or D-8) 2 motor graders 2 front-end loaders	2 pickup trucks 2 water trucks 2 dump trucks	8
Foundation Installation	3 augers 3 flatbed trucks w/booms 1 batch plant 6 concrete trucks	2 front-end loaders 3 (2-ton) trucks 3 pickup trucks 2 water trucks	36
Staging Area / Receiving	3 (40-ton) cranes 6 forklifts	3 pickup trucks	15
Structure Hauling	6 flatbed trailers 2 (2-ton) trucks	2 pickup trucks 2 forklifts	10
Structure Assembly	6 (40-ton) cranes 6 forklifts	6 flatbed trucks w/booms 12 pickup trucks	108
Structure Erection	3 (100-ton) cranes 6 (40-ton) cranes	12 pickup trucks	54
Wire Stringing	1 light helicopter 3 drum pullers 3 double-wheeled tensioners 9 wire reel trailers 3 splicing trucks 3 forklifts	3 diesel tractors 3 haul trailers 3 flatbed trucks w/booms 6 (2-ton) trucks 9 pickup trucks	120
Road/ROW Restoration	1 bulldozer (D-6 or D-8) 1 tractor with seeding equipment 1 motor grader	2 pickup trucks 1 water truck	6
Clean-up	1 front-end loader with bucket 1 dump truck	2 pickup trucks	4

Appendix A, *Transmission Line Construction Crews – Anticipated Size, Duration, and Equipment Utilization*, includes crew assumptions and details used in the development of the resource reports.

5.2.2 Transmission Line Construction Workforce (230 kV)

The estimated number of workers and types of equipment necessary to construct the proposed 230-kV transmission line are shown in Table 5-2. Additional equipment may be required on an as-needed basis to mobilize, maintain and demobilize the other equipment.

TABLE 5-2: ANTICIPATED CONSTRUCTION WORK FORCE AND EQUIPMENT (230 KV)

Activity	Equipment		Crew
Project Administration	5 pickup trucks		15
ROW Survey	1 helicopter 1 all-terrain vehicles (ATV)	1 pickup truck	4
Geotechnical Investigations	1 (2-ton) drill truck	1 pickup truck	3
Access Road Construction	1 bulldozer (D-6 or D-8) 1 motor grader 1 front-end loader	1 pickup trucks 1 water trucks 1 dump truck	4
Foundation Installation	3 augers 3 flatbed trucks with booms 6 concrete trucks 1 water truck	2 front-end loaders 3 (2-ton) trucks 3 pickup trucks	30
Staging Area / Receiving	2 (40-ton) cranes 4 forklifts	2 pickup trucks	8
Structure Hauling	3 flatbed trailers 1 (2-ton) truck 1 flatbed truck with boom	1 pickup truck 1 forklift	5
Structure Framing	1 (40-ton) crane 1 forklift	1 flatbed truck w/boom 2 pickup trucks	8
Structure Erection	1 (100-ton) crane	4 pickup trucks	15
Wire Stringing	1 light helicopter 2 drum pullers 2 double-wheeled tensioners 6 wire reel trailers 2 forklifts 2 splicing trucks	2 diesel tractors 2 haul trailers 2 flatbed trucks w/booms 4 (2-ton) trucks 12 pickup trucks	80
Road/ROW Restoration	1 bulldozer (D-6 or D-8) 1 tractor with seeding equipment 1 motor grader	2 pickup trucks 1 water truck	6
Cleanup	1 front-end loader with bucket 1 dump truck	2 pickup trucks	4

Appendix A, *Transmission Line Construction Crews – Anticipated Size, Duration, and Equipment Utilization*, includes crew assumptions and details used in the development of the resource reports.

5.2.3 Substation Construction Workforce

This section describes a typical workforce and equipment for substation construction. Crew size would vary based on the substation site and the phase of construction. In addition, indirect personnel, consisting of a project superintendent, safety representative, field engineer, inspectors, scheduler/cost controller, and QA administrator, would support each onsite project team. Power for construction crews would come from distribution lines (if in the area) or by diesel generators. Multiple substations would be under various stages of construction at any given time, with anticipated construction durations ranging from 4 to 15 months per substation.

TABLE 5-3: TYPICAL CONSTRUCTION WORK FORCE FOR SUBSTATION

Crew Member	Number of crew
General Foreman	2
Foreman	4
Leadsman	4
Journeyman	3
Craftsman	2
Carpenters	14
Apprentice	2
Operator	6
Laborers	2

TABLE 5-4: TYPICAL CONSTRUCTION SITE GRADING AND SURFACING EQUIPMENT FOR SUBSTATION

Equipment	Number of Equipment
CAT 623 Scraper	2
CAT 140H Blade	1
Mid-Size Dozer	1
Sheepfoot Roller	1
Water Truck	1
Smooth Drum Roller	1
Walk Behind Roller	1
CAT 950 loader	1
30-Ton Excavator	1

TABLE 5-5: TYPICAL CONSTRUCTION EQUIPMENT INSTALLATION AND STEEL ERECTION EQUIPMENT FOR SUBSTATION

Equipment	Number of Equipment
10,000 lb Forklift	2
Mini Excavator	1
Backhoe	1
40-Foot Manlift	2
60-Foot Manlift	2
90-Foot Manlift	1
Skidsteer loader	1
Trencher	1
60-Ton Crane	1

TABLE 5-6: TYPICAL CONCRETE INSTALLATION EQUIPMENT FOR SUBSTATION

Equipment	Number of Equipment
Drill Rig	1
Concrete Truck	Vary
Water Truck	1
Crane	1

Appendix B, *Substation Construction Crews – Anticipated Size, Duration, and Equipment Utilization*, includes crew assumptions used in the development of the resource reports.

5.3 Transmission Line Construction

5.3.1 Staging Areas

Construction of the proposed project would begin with the establishment of staging areas, which would be required for storing materials, construction equipment, and vehicles. Preliminary locations for staging areas have been identified based on the criteria described in Appendix C, *Staging Areas*. Staging area locations would be finalized following negotiations with landowners.

In some areas, only minimal site preparation would be required. Some areas may need to be scraped (typically 6-8 inches of topsoil is removed) by a bulldozer and a temporary layer of rock laid to provide an all-weather surface. Unless otherwise directed by the landowner, the rock would be removed from the staging area upon completion of construction, and the area restored. Staging areas might be fenced with locked gates and may have security if necessary. Fencing would be removed upon completion of construction.

A staging area can typically be constructed in 3-5 days. It is possible that one contractor would be used to sequentially build one staging area and then the next at the beginning of the proposed project. It is also possible that the construction of each staging area would be postponed until it becomes necessary.

It is highly unlikely that all staging areas would be active at the same time. Construction would occur in a serial fashion with access crews, foundation crews, structure assembly/erection crews, stringing crews, and cleanup crews following each other. Once the clean-up crew is done with a segment, the staging area serving that segment would be decommissioned. The amount of activity in a staging area would vary depending on which crews are using it at the time. Temporary staging areas would be powered by distribution lines (if in the area) or by a diesel generator otherwise.

Some staging areas would also be used for concrete batch plant operations. Batch plants would be located approximately every 25 miles along the alignment. Ideally they would be spaced so that no tower location is more than 15 miles from a batch plant. It is assumed that concrete is available in the major towns (Deming, Lordsburg, Willcox, Benson, and Tucson) and that concrete for any tower locations within 15 miles of the boundaries of those towns would be serviced by those facilities. Based upon those assumptions, the number of batch plants for the primary routes would be as follows (but this should be a valid assumption if alternate routes are used):

- 1 in Dona Ana County, NM
- 3 in Luna County, NM (2 if P3 leg is < 15 miles)
- 1 in Grant County, NM
- 0 in Hidalgo County, NM
- 3 in Cochise County, AZ (2 on 345-kV alignment; 1 on 230-kV alignment)
- 3 in Pima County, AZ

It is anticipated that each batch plant would typically be in operation for 3 to 6 months depending on location and the number of foundation crews relying on it. The hours of operation would vary but could be as much as 6 am to 6 pm, Monday-Saturday. It is anticipated that about 55,000 cy (~70% of the total concrete requirement for transmission lines) would be provided by temporary batch plants.

Batch plant operations typically occupy 3-5 acres of affected staging areas. It usually takes 3-5 days to set up a batch plant. Typically 6-8 inches of topsoil is removed using a bulldozer or motor grader and replaced with temporary gravel. A crane is used to set the equipment. Concrete batch plant sites would be reclaimed and revegetated to approximately pre-construction conditions, unless otherwise requested by the landowner.

5.3.2 Access Roads

Construction of the new transmission lines would require access to each new structure site for construction crews, materials, and equipment. Similarly, construction of other project components, such as representative staging areas, would require vehicle access. New access roads or access spur roads would be constructed using standard construction equipment such as a bulldozer or grader. Front-end loaders would be used to move the soil locally or offsite. Typically, 12-16-foot-wide straight sections of road and 16- to 20-foot-wide sections at corners would be required to facilitate safe movement of equipment and vehicles. Wherever possible, new access roads or spur roads would be constructed within the transmission line ROW, or existing streets and access roads would be used. Existing access roads may be improved for project use, as required. None of the access would be paved. It is anticipated that very few roads would be graveled. Exceptions to this may occur on a case by case basis and would likely be the result of one or more factors: (1) on heavily travelled roads leading to staging areas and substations; (2) in populated areas to aid in dust control; (3) in low spots subject to significant periods of mud. Construction of new down-line access is expected to take 2 to 5 days per mile. Upgrading existing access and construction new spur roads is expected to take 1 to 3 days per mile. Appendix D, *Access Roads – Characterization and Disturbance Estimates*, includes access road assumptions used in the development of the resource reports.

Once the route has been selected and the structures have been spotted, an access road plan will be developed. The access road plan would show the location of approved access to the right-of-way and to each structure site as well as any specialty sites such as staging areas and splicing sites. It would include large scale plan drawings showing existing roadways relative to the ROW and small scale plan drawings in the immediate vicinity of the ROW showing the location of new access, existing access in need of improvement, and existing access where no improvement is needed. The plan would include typical road cross-sections indicating the level of improvement required as well as the BMP's (Best Management Practices) to be followed. The construction specifications will include requirements for road construction and upgrades.

After project construction, existing and new permanent access roads would be used by maintenance crews and vehicles for inspection and maintenance activities. Temporary construction roads not required for future maintenance access would be removed and restored after project construction is complete. Gates would be installed, as required, to restrict unauthorized vehicular access to the ROW.

Appendix E, *Traffic Count Estimates*, includes the construction and maintenance traffic assumptions used in the development of the resource reports. Water trucks would be used for dust control. Appendix F, *Water Usage Estimates*, includes water usage assumptions (for dust abatement) used in the development of the resource reports.

5.3.3 Site Work

At each structure location, an area of approximately 200 feet by 100 feet as well as an adjacent area that is an extension of the access road would be cleared using a bulldozer or backhoe. Vegetation would be cleared only to the extent necessary for safe operations. Additional equipment may be required if solid rock is encountered at a structure location. Rock hauling, hammering, or blasting may be required to excavate the rock.

5.3.4 Foundation Installation

Each support structure would require the installation of foundations, which are typically drilled concrete piers, though some tubular steel structures may be direct embedded. Geotechnical borings would be obtained prior to final design and construction. It is anticipated that soil borings would be obtained at each major angle point and at representative locations in between.

No soils investigations would be performed on the ROW until after a proposed centerline is identified within an approved corridor. It is anticipated that most of the geotechnical data would be collected soon after the ROW grant. In order to get construction started as soon as possible, it would be desirable to obtain geotechnical data on select line segments prior to the ROW grant. Early data collection for design would be subject to BLM/landowner permitting requirements, would likely be restricted to less sensitive areas, and likely could be coordinated with environmental surveys to minimize disturbance. It is also possible that data would be obtained as part of the route selection process in areas of specific geotechnical concern (e.g. Willcox Playa), in order to evaluate the need for special construction techniques and their corresponding impacts on certain segments.

Foundation depths would be consistent with geotechnical conditions at the structure site. First, drilled shafts would be excavated for each structure: four holes for each lattice tower, and one hole for each single shaft tubular steel structure. The holes would be drilled using a truck-mounted excavator equipped with augers of various sizes depending on the diameter and depth requirements of the hole to be drilled. The lattice tower holes would be approximately 4 feet in diameter and the holes for the tubular steel structures would be approximately 8 feet in diameter. Excavation spoils would be evenly spread out within the ROW in the vicinity of each structure, unless specifically prohibited by the landowner. Spoils would be crowned around the foundations to provide positive drainage away from them.

Where solid rock is encountered, blasting, rock hauling, or the use of a rock anchoring or mini pile system may be required. The rock anchoring or mini-pile system would be used in areas where site access is limited or where adjacent structures could be damaged as a result of blasting or rock hauling activities. Such anchoring systems may also be used where economically and technically justified. Materials used for rock anchoring or mini-pile systems would be stored in the staging areas and not on the ROW. In areas where it is not possible to operate large drilling equipment due to access or environmental constraints, hand digging may be required.

For tubular steel structures on concrete pier foundations, steel reinforcing cages and anchor bolt cages would be installed after excavation and prior to concrete placement and structure installation. Direct embedded tubular steel structures would be installed after excavation and then backfilled. For lattice towers, steel reinforcing cages and stub angles would be installed. The foundations would be designed to satisfy all Federal, State, and local design codes.

Typically, concrete would be delivered directly to the site in concrete trucks with a capacity of up to 10 cubic yards. However, in areas with limited access or environmental constraints, the concrete would be placed in the excavation with either a crane and garbro bucket, or pumped from a distance of several hundred feet. Each foundation would extend approximately 2 feet above the ground level.

Water would be required for concrete mixing. Appendix F, *Water Usage Estimates*, includes water usage assumptions (for water in concrete) used in the development of the resource reports. Appendix F, *Water Usage Estimates*, also includes estimated sizes of foundations.

5.3.5 Structure Erection

At local assembly and staging areas, materials would be staged and subassemblies may be fabricated. From these local assembly and staging areas, material and subassemblies would be delivered to the tower/pole sites via flatbed truck.

Subsequent to full or partial assembly, sections of the structure would be assembled adjacent to the structure location and lifted onto the foundation using a large crane of suitable capacity. The crane would move along the ROW as towers are erected.

5.3.6 Wire Stringing

Conductor and shield wire would be placed on the transmission line support structures by a process called stringing. Conductors with a non-specular finish would be suspended from insulator assemblies. Overhead shield wires would be located on the peaks of each transmission structure and function to intercept lightning that would otherwise strike the conductor. All structures with a single shield wire peak would have a fiber optic shield wire installed at the structure peak. All structures with dual shield wire peaks would have a fiber optic shield wire installed on one peak and a steel shield wire installed on the other peak. Additionally, a grounding system would be installed at the base of each transmission structure that would consist of copper ground rods embedded into the ground in immediate proximity to the structure foundation and connected to the structure by buried copper lead. No under-built lower voltage transmission or distribution lines would be installed unless dictated by the permitting process.

The first step to conductor and shield wire stringing would be to install insulators and stringing sheaves. Stringing sheaves are rollers that are temporarily attached to the lower portion of the insulators at each transmission line support structure to allow conductors to be pulled along the line. A lightweight rope known as a finger line may be placed through each sheave with each end extending to the ground. Additionally, temporary clearance structures would be erected where required prior to stringing any transmission lines. The temporary clearance structures are typically vertical wood poles with cross arms and are erected at road crossings or crossings with other energized electric and communication lines to prevent contact during stringing activities. Bucket trucks may also be used to provide temporary clearance. Bucket trucks are trucks fitted with a hinged arm ending in an enclosed platform called a “bucket,” which can be raised to let the worker in the bucket service aerial equipment.

Once the stringing sheaves and temporary clearance structures are in place, the initial stringing operation would commence. This would consist of pulling a pilot line through the sheaves, using the finger lines, along a section of the alignment. The pilot line is attached to the hard line, which follows the pilot line as it is pulled through the sheaves. The hard line would then be attached to the conductor or shield wire to pull it through the sheaves into its final location. Pulling the pilot line may be accomplished by attaching it to a specialized vehicle or to a small helicopter that moves along the ROW.

Pulling and tensioning would be used to install the hard line and the wires and achieve the correct sagging of the transmission lines between support structures. Pulling and tensioning sites would be required about every 3 miles along the ROW and would encompass approximately 1 to 2 acres to accommodate required equipment. Approximately 40 wire pulling/tensioning sites on the 230-kV segment and approximately 80 wire pulling/tensioning sites on the 345-kV segment would be required. Equipment at sites required for pulling and tensioning activities would include tractors and trailers with spooled reels that hold the conductors, and trucks with the tensioning equipment. To the extent practicable, pulling and tensioning sites would be located within the ROW. Depending on topography, minor grading may be required at some sites to create level pads for equipment. Wire splicing sites would be located midway between each pair of pulling/tensioning sites (about every 3 miles), but they would not normally require any grading. Approximately 40 splicing sites on the 230-kV segment and approximately 80 splicing sites on the 345-kV segment would be required. Finally, the tension and sag of conductors and shield wires would be fine-tuned, the conductors would be permanently attached to the insulators at the support structures, and the stringing sheaves would be removed.

5.3.7 Helicopter Construction

The construction contractor(s) would ultimately decide the need for helicopter usage on the proposed project. Given the flat terrain, good access, and current schedule for the proposed project, it is unlikely that helicopter construction would be used for the erection of structures. However, should it be decided later that structure erection by helicopter would be needed, a Helicopter Use Plan would be developed. The actual hours of operation and expected number of miles of structures that could be erected per day would be described in the Helicopter Use Plan.

It is common to use a light helicopter to string the pilot line. (The pilot line is then attached to a hard line on the ground, which in turn is attached to the conductor for actual pulling of the conductor.) If utilized, the light helicopter would be operating about 8 hours per week during the stringing phase of construction and its use would also be described in the Helicopter Use Plan.

5.3.8 Disposal and Cleanup

Construction would generate non-hazardous solid wastes, including material packaging, concrete, hardware, and scrap metal. However, the volume of these wastes is not expected to be significant. Personal trash would be removed from the ROW on a daily basis. Construction waste (boxes, crates, etc.) would be removed from the transmission line ROW shortly after each crew (e.g. erection crew) completes their task at a site. The solid wastes generated during construction would be hauled away for recycling or disposal at approved disposal sites. Approximately 10 dumpsters per month would be generated at each active staging site.

5.4 Substation Construction

5.4.1 Substation Roads

Substation roads would be constructed using a bulldozer or grader, followed by a roller to compact and smooth the ground. Front-end loaders would be used to move the soil locally or offsite. Either gravel, chip seal, or asphalt would be applied to the prepared base layer. Appendix E, *Traffic Count Estimates*, includes the construction and maintenance traffic assumptions used in the development of the resource reports.

5.4.2 Soil Borings

Typically, soil borings would be made at three to four locations in the substation, particularly at the approximate location of large structures and equipment, such as transmission line dead ends and transformers, to determine the engineering properties of the soil. Borings would be made with truck or truck-mounted equipment. The borings would be approximately 4 inches in diameter, range from 30 to 60 feet in depth, and would be backfilled with the excavated material upon completion of soil sampling.

5.4.3 Clearing and Grading

Clearing of all vegetation would be required for the entire substation area, including a distance of about 10 feet outside the fence. This is required for personnel safety due to grounding concerns and because of lower clearances to energized conductors within the substation as compared to transmission lines. These lower clearances are allowed by the NESC because the entire substation is fenced.

Vegetation is removed and a 4- to 6-inch layer of crushed rock is applied to the finished surface of the substation. The substation is usually then treated with a soil sterilizer to prevent vegetation to ease maintenance. The entire substation area would be graded essentially flat, with just enough slopes to provide for runoff of precipitation. The substation would be graded to use existing drainage patterns to the extent possible. In some cases, drainage structures, such as ditches, culverts, and sumps, may be required to control runoff. Cleared and graded material would be disposed of in compliance with local ordinances. Material from offsite would be obtained at existing borrow or commercial sites and trucked to the substation using existing roads and the substation access road.

Stormwater runoff containment ponds may be installed to moderate the discharge of stormwater offsite if determined to be necessary in the course of design.

Appendix G, *Substation Disturbance Estimates*, includes disturbance assumptions used in the development of the resource reports.

5.4.4 Material Storage Yards

Construction material storage yards may be part of the substation property or leased by the contractor. Storage areas for substations would be up to 10 acres in size and may be shared with the transmission line crews. After construction is completed, all debris and unused materials would be removed and the storage yards returned to preconstruction conditions by the construction contractor or as otherwise restored per agreement.

5.4.5 Grounding

A grounding system is required in each substation for fault protection and personnel safety. The grounding system typically consists of buried copper conductor arranged in a grid system and driven ground rods of adequate size, typically 8 to 10 feet long. The ground rods and any equipment and structures are connected to the grid conductor. The amount of conductor, size, length, and number of ground rods required is calculated based on fault current and soil characteristics. All metal structures and equipment are connected to the ground grid via grounding pig tails. The ground grid is extended to approximately 4 feet outside of perimeter fence to prevent unsafe reach-touch potentials.

5.4.6 Fencing

Security fencing is installed around the entire perimeter of each new or expanded substation to protect equipment and prevent accidental contact with energized electrical equipment by authorized and unauthorized personnel. The fence is a 7-foot-tall chain-link fence with steel posts. One foot of barbed wire is installed on top of the fence, yielding a total fence height of 8 feet. Locked gates would be installed at appropriate locations for authorized vehicle and personnel access.

5.4.7 Foundation Installation

Foundations for supporting structures would be drilled piers. Pier foundations are placed in a hole generally made by a truck-mounted auger. Reinforced steel and anchor bolts are placed into the hole using 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 dressed.

Equipment foundations for circuit breakers and transformers would be slab-on-grade type. These foundations 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 dressed.

Where necessary, provision would be made in the design of the foundations to mitigate potential problems due to frost. Reinforced steel and anchor bolts would be transported to each site by truck, either as a prefabricated cage or loose pieces, which would then be fabricated into cages on the site. Concrete would be hauled to the site in concrete trucks. Water would be required for concrete mixing. Appendix F, *Water Usage Estimates*, includes estimated quantities of foundations, estimated concrete volumes of foundations, and estimated water usage assumptions (for water in concrete) used in the development of the resource reports. Excavated material would be spread at the site or disposed of in accordance with local ordinances and per agreement. Structures and equipment would be attached to the foundations by means of threaded anchor bolts embedded in the concrete. Some equipment such as transformers may not require anchor bolts. They would be secured to the foundation by other means.

5.4.8 Oil Containment

Transformers are filled with an insulating mineral oil. Containment structures are required to prevent equipment oil from getting into the ground or water bodies 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 oil containment is a pit, of a calculated capacity, located under the oil-filled equipment that has an oil impervious liner. The pit is filled with rock to grade level. In the event of an oil leak or rupture, the oil captured in the containment pit is pumped into tanks or barrels and transported to a disposal facility. If required, more elaborate oil containment systems can be installed. This may take the form of oil-water separator method depending on site requirements. An oil spill prevention preparedness plan would be developed in conjunction with the operating utility as required.

5.4.9 Structure and Equipment Installation

Supporting steel structures are erected on concrete foundations. These are set with a truck-mounted crane and attached to the foundation anchor bolts by means of a steel base plate. These structures would be used to support the energized conductors and certain types of equipment. This equipment is lifted onto the structure by means of a truck-mounted crane and bolted to the structures, and electrical connections are then made. Some equipment, such as transformers and circuit breakers, is mounted directly to the foundations without supporting structures. These are 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 are then made.

5.4.10 Control Building Construction

One or more control buildings are required at each substation to house protective relays, control devices, battery system for primary control power, and remote control and monitoring equipment. The size and construction of the building depend on individual substation requirements. Typically, the control building would be constructed of concrete block, pre-engineered metal sheathed, or composite surfaced materials. Once the control building is erected, equipment is mounted and wired inside. In the case of a pre-engineered building, all internal wirings are performed at the building manufacturer's factory.

5.4.11 Conductor Installation

Two main types of high-voltage conductors are used in substations: tubular aluminum for rigid bus sections and/or stranded aluminum conductor for strain bus and connections to equipment. Rigid bus would be supported by porcelain insulators installed on steel supports. The bus sections would be welded together and attached to special fittings for connection to equipment. Stranded aluminum conductors would be used as flexible connectors between the rigid bus and the station equipment.

5.4.12 Conduit and Control Cable Installation

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

5.4.13 Construction Cleanup

The cleanup operation would be performed after construction activities are completed. All waste and scrap material would be removed from the site and disposed in local permitted landfills in accordance with local ordinances. Approximately 10 dumpsters per month would be generated at each active substation site. Ruts and holes outside the substation fence due to construction activities would be regraded. Revegetation and restoration would be conducted as required.

5.5 Telecommunication Regeneration Station Construction

Small sites would be required for fiber optic and microwave regeneration facilities that are remote from the substations.

5.5.1 Access Roads

Access roads would be constructed using a bulldozer or grader, followed by a roller to compact and smooth the ground. Front-end loaders would be used to move the soil locally or offsite. Gravel would be applied to the prepared base layer.

5.5.2 Soil Borings

Typically, soil borings would be made at multiple locations in the site, particularly at the approximate location of large structures, such as a microwave tower or a regeneration building, to determine the engineering properties of the soil. Borings would be made with truck or truck-mounted equipment. The borings would be approximately 4 inches in diameter, range from 30 to 60 feet in depth, and would be backfilled with the excavated material upon completion of soil sampling.

5.5.3 Clearing and Grading

Clearing of all vegetation would be required for the entire area. Typically, vegetation is removed and aggregate is applied to the finished surface of the site. The site is usually then treated with a soil sterilizer. The entire site area would be graded essentially flat, with just enough slopes to provide for runoff of precipitation. The site would be graded to use existing drainage patterns to the extent possible. In some cases, drainage structures, such as ditches, culverts, and sumps, may be required to control runoff. Cleared and graded material would be disposed of in compliance with local ordinances. Material from offsite would be obtained at existing borrow or commercial sites and would be trucked to the site using existing roads.

5.5.4 Grounding

A grounding system is required in each station for personnel safety. The grounding system typically consists of buried copper conductor arranged in a grid system and driven ground rods of adequate size, typically 8 to 10 feet long. The ground rods and any equipment and structures are connected to the grid conductor. The amount of conductor, size, length, and number of ground rods required is calculated based on fault current and soil characteristics. All metal structures and equipment are connected to the ground grid via grounding pig tails.

5.5.5 Fencing

Security fencing is installed around the entire perimeter of each new site to protect equipment and prevent accidental contact with energized electrical equipment by authorized and unauthorized personnel. The fence is a 7-foot-tall chain-link fence with steel posts. One foot of barbed wire is installed on top of the fence, yielding a total fence height of 8 feet. Locked gates would be installed at appropriate locations for authorized vehicle and personnel access.

5.5.6 Foundation Installation

Foundations for supporting structures are of drilled piers. Pier foundations are placed in a hole generally made by a truck-mounted auger. Reinforced steel and anchor bolts are placed into the hole using a 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 dressed.

Where necessary, provision would be made in the design of the foundations to mitigate potential problems due to frost. Reinforced steel and anchor bolts would be transported to each site by truck, either as a prefabricated cage or loose pieces, which would then be fabricated into cages on the site. Concrete would be hauled to the site in concrete trucks. Excavated material would be spread at the site or disposed of in accordance with local ordinances and per agreement. Structures and equipment would be attached to the foundation by means of threaded anchor bolt embedded in the concrete. Some equipment may not require anchor bolts. They would be secured to the foundation by other means.

5.5.7 Regeneration Building Construction

A regeneration building is required at each site to house telecommunication equipment and battery system for monitoring equipment. The size and construction of the building is approximately 20-feetby 20-feet. Typically, the building would be constructed of concrete block, pre-engineered metal sheathed, or composite surfaced materials. Once the building is erected, equipment is mounted and wired inside. In the case of a pre-engineered building, all internal wirings are performed at the building manufacturer’s factory.

5.5.8 Construction Cleanup

The cleanup operation would be performed after construction activities are completed. All waste and scrap material would be removed from the site and disposed in local permitted landfills in accordance with local ordinances. Ruts and holes outside the site fence due to construction activities would be regraded. Revegetation and restoration would be conducted as required.

6 OPERATION AND MAINTENANCE

6.1 Transmission Line Maintenance

Following project construction, operation and maintenance (O&M) of the new line would commence. Necessary work areas around all structures would be kept clear of vegetation and the height of vegetation along the ROW would be limited. Other than weed control, the need for vegetation management should be minimal due to the presence of low/slow growing vegetation. If required, it would be performed on an annual basis. The following section provides details on the anticipated O&M requirements for the proposed project.

Regular inspection of transmission lines, substations, and support systems is critical for safe, efficient, and economic operation. Early identification of items needing maintenance, repair, or replacement would ensure continued safe operation of the proposed project. Regular ground and aerial inspections would be performed in accordance with the applicable requirements. The conductors would be inspected for corrosion, equipment misalignment, loose fittings, and other mechanical problems. The need for vegetation management would also be determined during inspection patrols. Inspection (visual and infrared) of the entire system and climbing inspections of transmission structures would be conducted annually. Aerial inspection would be conducted by helicopter. Ground inspections would be conducted by up to three crewmembers as needed. Based on industry experience, these inspections are anticipated every 1 to 2 years.

Electrical equipment housed on poles or support structures may include conductors, insulators, shield wires, fiber optic lines, and related equipment. This equipment may require addition, replacement, or repair over time. Typically, equipment repair or replacement would be conducted by a four-person crew with two or three trucks, a boom or line truck, an aerial truck, and an assist truck. Emergency maintenance may be required on rare occasions to repair damaged wires, insulators, or structures.

Arcing can occur when an electrical discharge is created from the combination of atmospheric condensation and dust on insulators. Arcing may cause electrical outages, but can be prevented by routinely washing the insulators to keep them free of dust. Insulator washing involves driving a water truck to within 6 feet of a tower base and using a high-pressure hose to spray deionized water onto the insulators. Two crewmembers and a water truck are required for insulator washing. Typically, insulator washing takes approximately 30 minutes per transmission structure. Insulator washing is not expected more than twice a year and would require approximately 300 gallons of water per structure and 3,000 gallons of water per day.

ROW repairs would include grading or repair of existing maintenance access roads and work areas, and spot repair of sites subject to flooding or scouring. Activities related to ROW repair are usually conducted outside of the rainy season. Required maintenance equipment may include a motor grader, backhoe, four-wheel drive pickup truck, and a front-end loader. The loader has steel tracks or large tires whereas the grader, backhoe, and truck would typically have rubber tires.

A minimum clearance of 10 feet would be maintained around the base or foundation of all electrical transmission structures. Where practicable, vegetation that does not pose a fire hazard or physical impedance would not be cleared. In addition, work areas would be maintained adjacent to access roads and electric transmission structures for vehicle and equipment access necessary for operations, maintenance and repair. Shrubs and other obstructions would be regularly removed near structures to facilitate inspection and maintenance of equipment and to ensure system reliability. In addition, vegetation with a mature height of 15 feet or taller would not be allowed to grow within 10 vertical feet of any overhead conductor in order to protect system reliability and public safety.

Vegetation would be removed using mechanical equipment, such as chain saws, weed trimmers, rakes, shovels, mowers, and brush hooks. The duration of activities and the size of crew and equipment required would be dependent on the amount and size of the vegetation to be trimmed or removed. Most vegetation removal or tree trimming activities can be completed in 1 day. Occasionally, herbicide is applied subsequent to vegetation clearing to prevent regrowth of vegetation. One or a combination of herbicides, which are listed in U.S. Fish and Wildlife

Service (USFWS) recommendations, would be used. Local application of herbicide would occur within a limited radius of each structure. Aerial application of herbicide would not be performed.

Fire protection jurisdictions would be consulted to ensure implementation and effectiveness of safety requirements and procedural protocols, including fire response plans. The following practices may be implemented to prevent fire during construction and maintenance/repair activities: 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, and providing "fire behavior" training to all pertinent personnel.

Maintenance responsibilities for the project have not been determined but will likely be assigned to organizations with existing maintenance facilities. New maintenance yards (if required) would be located on private land, likely utilizing a previously disturbed facility.

6.2 Substation and Regeneration Station Maintenance

Substation and regeneration stations are unmanned stations. Monitoring and control are performed remotely. Unauthorized entry into facilities 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. Remotely monitored security systems would be installed. Several forms of security are planned for each of the locations. Security measures may include fire detection in the control building via the remote monitoring system and 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 to the system operator of disturbances at the fence line.

Maintenance activities include equipment testing, equipment monitoring and repair, and emergency and routine procedures for service continuity and preventive maintenance. It is anticipated that maintenance at each substation would require approximately six trips per year by two- to four-person crew. Routine operations would require one or two workers in a light utility truck to visit the substations monthly. Typically, a major maintenance inspection would take place once per year, requiring up to 15 personnel for 1 to 3 weeks. Regeneration stations would be visited every 2 to 3 months by one individual in a light truck to inspect the facilities. Annual maintenance would be performed by a two-person crew in a light truck over a 2- to 5-day period.

Lighting at the substation would be provided inside the substation fence. Maintenance crews would bring adequate lighting for the purposes of emergency repair work.

Maintenance responsibilities for the project have not been determined but will likely be assigned to organizations with existing maintenance facilities. New maintenance yards (if required) would be located on private land, likely utilizing a previously disturbed facility. Southline Transmission, LLC is expected to be the owner of the Midpoint Substation. It has not been determined who would be the operator.

7 DECOMMISSIONING

The proposed transmission line would have a projected operational life of 50 years or longer. At the end of its service, the transmission line would be removed. At such time, conductors, insulators, and hardware would be dismantled and removed from the ROW. Structures would be removed and foundations 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 substation is no longer required, the substation structures and equipment would be dismantled and removed from the site. The station structures would be disassembled and either reused 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 either abandoned in place or cut off below ground level and buried.

The Applicant would reclaim service roads following abandonment and in accordance with the landowner's direction. Roads would be reclaimed and seeded as soon as possible during the optimal seeding season. In some cases, reseeding may not be necessary, given the existing amount of soil compaction and vegetation currently in place. Where required by the land management agency, compacted areas would be ripped and appropriate sediment control measures would be implemented.

8 ENVIRONMENTAL RESOURCES AND MITIGATION

This section first describes biological, air quality, agricultural, and noise impacts of the proposed project, because they are expected to be similar on a regional basis, or the same impact conclusions apply to all areas of the proposed project. It then describes potential impacts that might occur depending on site-specific considerations. The Applicant would conduct surveys of cultural and biological resources as directed by the BLM and Western during the NEPA review process, and the NEPA compliance document would analyze potential project impacts in detail. This section is intended to provide an overview.

8.1 Preliminary Environmental Information

8.1.1 Air Quality

The air quality impacts of the proposed project would occur primarily during the construction phase. Emissions during O&M would be minimal. Over the life of the proposed project, higher emissions during the years of construction would be followed by much lower emissions during the years of activity necessary to support transmission line operation. Construction emissions from equipment and vehicles would create emissions of ozone precursors, particulate matter, and carbon monoxide, resulting from generation of dust and exhaust emissions of criteria pollutants and toxic air contaminants. Applicant proposed Mitigation measures (APMs) are proposed to reduce construction and operation emissions, including measures to suppress dust at all work or staging areas and on public roads.

8.1.2 Biological Resources

While the Applicant has selected the route study area to avoid areas of critical environmental concern and sensitive habitat, impacts could potentially affect native vegetation, listed or sensitive plants or habitat for listed or sensitive plants, and listed or sensitive wildlife or its habitat. Prior to construction, the Applicant would conduct all necessary biological surveys. During construction, the Applicant would take measures to avoid direct impacts to sensitive species where practicable. It is envisioned that areas of the ROW that are habitat for such species would be surveyed prior to construction.

During operation, impacts are expected to be minimal. However, the overhead lines may pose a hazard to raptors and other birds. The Applicant would work with the responsible agencies and experts to incorporate the appropriate design mitigation measures.

8.1.3 Agriculture

The route has been selected to avoid agricultural lands. However, establishment of the transmission line corridor may impact some agricultural uses. Livestock grazing should not be significantly impeded by the proposed project.

8.1.4 Noise

Noise impacts would be similar for all areas of the proposed project where sensitive receptors would be in proximity to the line. Noise impacts during construction would result from the use of equipment and vehicles but would be limited to the immediate vicinity of the proposed overhead line, along the proposed project route, and along all transport access routes. During operation, corona noise caused by operation of the new 345-kV transmission line would elevate the current ambient noise levels within the immediate vicinity of the edge of the ROW.

During operation, maintenance activities would involve noise at levels similar but less extensive than transmission line construction.

8.1.5 Visual Resources

The installation of new transmission towers could affect travelers on local roads, recreationists, and local residents. During the NEPA review process, the Applicant envisions that the route would be surveyed to identify key observation points.

8.1.6 Wilderness and Recreation

Presence of the transmission structures and corona noise could potentially affect the recreational experience along the ROW. However, the proposed route has been selected to avoid designated wilderness and recreation areas. If practicable, the Applicant prefers to site the crossing of the Continental Divide Trail at a location already impacted by an existing road or ROW.

8.1.7 Cultural Resources

Construction could affect historic properties, unknown buried resources, and sites that might contain Native American human remains. Prior to construction, the Applicant would conduct studies of the proposed ROW in order to identify significant cultural resources, if any.

8.1.8 Socioeconomics

Construction-period disturbances to recreational activities may temporarily affect access to recreational areas. However, spending by the proposed project and its construction labor force is expected to have a positive impact on local communities.

8.2 Anticipated Permit Approvals

The proposed project would require approvals from Federal, State, and local agencies. A preliminary list of permits that may be required is presented in the following table (Table 8-1).

TABLE 8-1: PROJECT PERMITS POTENTIALLY REQUIRED FROM FEDERAL, STATE, AND LOCAL AGENCIES

Regulatory Authority	Permit / Approval	Report /Permit Requirements
FEDERAL		
BLM	Application for Transportation and Utility Systems and Facilities on Federal Lands (SF 299) (Right-of-Way Authorization Permit)	This Right-of-Way Authorization Permit serves all commercial energy facilities. EIS provides analysis to support BLM decisions.
BLM	Plan of Development (POD)	Plan for construction and operation of facility must be completed prior to beginning construction. Plan provides full project description, including Applicant information, site location, maps, and proposed operating plan.
BLM	NEPA review and record of decision / ROW grant/notice to proceed	EIS documents conformity with Resource Management Plans and other Federal, state and local regulatory requirements.
BLM	National Historic Preservation Act (NHPA) Section 110; EO11593	1. Conduct Class I inventory (e.g., file search for sites within area of potential effect [APE]). 2. Conduct 100 percent Class III survey of APE for New Build Section and re-evaluate the identified sites from a previous survey conducted by Western for the Upgrade Section. 3. If any historic structures are present, additional documentation could be needed.
BLM to contact Arizona and New Mexico State Historic Preservation Offices and Tribal Historic Preservation Office (as appropriate)	NHPA, Section 106 Review (36 CFR 800)	Compliance with Section 106.

TABLE 8-1: PROJECT PERMITS POTENTIALLY REQUIRED FROM FEDERAL, STATE, AND LOCAL AGENCIES

Regulatory Authority	Permit / Approval	Report /Permit Requirements
U.S. Army Corps of Engineers	Section 404 permit: Preconstruction Notification or Individual Permit	Wetland delineation and permit.
U.S. Environmental Protection Agency (New Mexico does not have its own State program)	National Pollutant Discharge Elimination System	Stormwater pollution prevention plan (SWPPP) and Notice of Intent (NOI).
USFWS	Biological Opinion/Incidental Take Permit	Endangered Species Act (ESA) Section 7 consultation and biological assessment.
STATE		
Arizona Corporation Commission	Application for Certificate of Environmental Compatibility	Environmental report and application exhibits.
Arizona State Land Department	Right-of-Way Grant	Requires cultural resources survey and report and native plant inventory report and payment of stumpage fees.
Arizona Department of Transportation	Encroachment into State Highway rights-of-way, rights-of-way occupancy permits	Requires biological evaluation and cultural resources survey and reports of highway ROW.
ADEQ - Arizona Department of Environmental Quality	Arizona Pollution Discharge Elimination System	SWPPP and NOI.
Arizona Game and Fish Department (AGFD)	Handling Permit	
New Mexico Department of Transportation	Encroachment into State Highway rights-of-way, rights-of-way occupancy permits	Requires biological evaluation and cultural resources survey and reports of highway ROW.
New Mexico State Land Department	Right-of-Way Grant	Requires cultural resources survey.
New Mexico Public Regulation Commission	To be determined	
LOCAL		
County Floodplain Departments	Floodplain Use Permit	Required for development in flood-prone areas as defined by the Federal Emergency Management Agency.
County Air Quality District	Fugitive Dust Control Permit	Management of particulates generated by construction at the site is required; primarily typical best management practices (BMPs) are employed and would be documented in the permit application.
County Transportation Departments	County Encroachment Permits for the Transmission Line	Requires project plans to document the encroachment.

8.3 Applicant Proposed Measures for the Southline Transmission Project

8.3.1 Air Quality and Climate Change

APM AIR-1: Enhanced Dust Control Measures.

The following dust control measures would be implemented: 1) frequent watering or stabilization of excavations, spoils, access roads, storage piles, and other sources of fugitive dust (parking areas, staging areas, other) if construction activity causes persistent visible emissions of fugitive dust beyond the work area; 2) reduction in the amount of disturbed area where possible; and 3) planting of vegetative ground cover, as appropriate, in disturbed areas after construction activities have ended.

APM AIR-2: Best Management Practices for Greenhouse Gas Reduction.

Southline would follow best management practices (BMPs) to reduce the potential for greenhouse gas emissions, including 1) ensuring that only knowledgeable personnel handle sulfur hexafluoride (SF6), and 2) implementing SF6 recovery and recycling.

8.3.2 Cultural Resources

APM CR-1: Cultural Resources Inventory.

Southline would conduct a Class III pedestrian cultural resources survey of the proposed project corridor and a 50-foot buffer to identify all cultural resources that may be adversely impacted by the proposed project. The Class III survey would be conducted to meet all the requirements detailed in the BLM Handbook. A Class III cultural resources inventory report that includes recommendations for site eligibility for inclusion on the National Register of Historic Places (NRHP) would be submitted to the BLM and Western for review and concurrence. Potential project impacts to each site would be identified. All historic period buildings would be recorded by a qualified architectural historian, as required by New Mexico regulations.

APM CR-2: Archaeological Resources Protection Act Training.

Prior to construction, the Applicant would provide Archaeological Resources Protection Act training to all construction supervisory personnel who have the potential to encounter and alter unique archaeological sites, historical resources, or historic properties, or properties that may be eligible for listing in the NRHP.

APM CR-3: Historic Properties Treatment Plan.

A historic properties treatment plan (HPTP) would be developed and implemented to mitigate the adverse effects of the proposed project on known cultural resources. Mitigation measures may range from avoidance and preservation in place to data recovery excavations conducted prior to the destruction of a site if avoidance is not a feasible option. The HPTP would include a monitoring and discovery plan detailing procedures to be followed in the inadvertent discovery of a potentially significant archaeological site. To the extent practical, Southline would work with our cultural resources specialists to design the proposed project to avoid or minimize impacts on historic or archaeological resources, regardless of their eligibility status. This includes siting all ground-disturbing activities and other project components outside a buffer zone established around each recorded archaeological site within or immediately adjacent to the ROW.

APM CR-4: Avoid Direct Impacts on Significant Cultural Resources through Project Final Design.

Project final design would avoid direct impacts on significant or potentially significant cultural resources. To the extent practical, all ground-disturbing activities and other project components would be sited to avoid or minimize impacts on cultural resources listed as, or potentially eligible for listing as, unique archaeological sites, historical resources, or historic properties.

APM CR-5: Protective Buffer Zones.

Establish and maintain a protective buffer zone around each recorded archaeological site within or immediately adjacent to the ROW that would be treated as an “environmentally sensitive area” within which construction activities and personnel are not permitted.

APM CR-6: Evaluate Significance of Potentially Eligible Resources.

Evaluate the significance of archaeological resources, buildings, and structures in terms of their eligibility for inclusion on the NRHP.

APM CR-7: Minimize Ground Disturbance.

To the extent practical, all activities would minimize ground surface disturbance within the bounds of significant archaeological sites, historical resources, or historic properties.

APM CR-8: Prepare and Implement a Construction Monitoring and Unanticipated Cultural Resources Discovery Plan.

During construction, it is possible that previously unknown archaeological or other cultural resources or human remains could be discovered. Prior to construction, the Applicant would prepare a construction monitoring and unanticipated cultural resources discovery plan to be implemented if an unanticipated discovery is made.

8.3.3 Farming and Rangeland

APM FARM-1:

If fences or gates are inadvertently damaged during construction, Southline would arrange to have them repaired or replaced promptly.

8.3.4 Geology and Minerals

APM GEO-1: Geotechnical Engineering Study.

Southline would prepare a geotechnical engineering study prior to the final project design to identify site-specific geological conditions and potential geologic hazards. The data collected from the study would be used to guide sound engineering practices and mitigate potential geologic hazards.

8.3.5 Hazardous Materials and Waste

APM HAZ-1: Hazardous Materials and Hazardous Waste Management Program.

A project-specific hazardous materials and hazardous waste management program would be developed prior to construction of the proposed project. The program would outline proper hazardous materials use, storage, and transport requirements and applicable handling procedures. The program would identify the types of hazardous materials to be used during the proposed project and the types of hazardous wastes that are expected to be generated. All debris generated during project-related demolition of structures, buildings, asphalt, or concrete-paved surface areas would be managed in a manner that would minimize risks to workers, the public, and the environment. Waste materials determined to be hazardous waste would be recycled or disposed of at a permitted hazardous waste management facility. Used oil would be sent offsite for recycle/reuse or otherwise managed for safe disposal. Containers used to store hazardous materials and hazardous wastes would be properly labeled and maintained in good condition. Construction and O&M personnel would be provided with project-specific training to safely manage hazardous materials and hazardous wastes.

APM HAZ-2: Sampling of Backfill Material.

If backfill material to be used is derived from a site that is suspected to have contamination, it would be sampled and determined to be free of regulated contaminants before it is used to fill excavations.

APM HAZ-3: Environmental Site Assessment.

New or expanded substation locations that involve the purchase or long-term leasing of land, purchased transmission line ROWs, and any other property to be acquired would be screened for environmental liabilities. The degree and level of screening would be based on knowledge or information available on the property to determine the probability of contaminants of concern or other environmental impairment. A Phase I environmental site assessment (ESA) would be conducted if preliminary screening indicates a reasonable risk that such environmental conditions may exist on the property and the property continues to be targeted for acquisition by the proposed project. The Phase I ESA would be conducted by an environmental professional, who would produce a report consistent with American Society for Testing and Materials Standard E1527-05 or the latest applicable version of that standard. If the report identifies areas of concern that could impact the proposed project or the planned use of the land, actions may include additional assessment, characterization, remediation, or selection of alternative property.

APM HAZ-4: Soil Management Plan.

A soil management plan would be developed and implemented for construction of the proposed project. The objective of the soil management plan is to provide guidance for the proper handling, onsite management, and disposal of impacted soil that might be encountered during construction activities. Appropriately trained personnel would be onsite during preparation, grading, and related earthwork activities to monitor the soil conditions encountered.

APM HAZ-5: Spill Prevention, Countermeasure, and Control Plan.

In the event of a spill, workers would immediately cease work, begin spill cleanup operations, and notify appropriate agencies as required by law. Southline would prepare a spill prevention, countermeasure, and control plan for proposed and/or expanded substations with the applicable quantity of oil in order to minimize, avoid, and/or clean up unforeseen spills during facility operations.

APM HAZ-6: Nonhazardous Construction Waste Disposal Plan.

All construction and demolition waste, including trash and litter, garbage, and other solid waste, would be removed and transported to an appropriately permitted recycling or disposal facility. Southline would prepare a construction waste disposal plan for all nonhazardous wastes generated during construction of the proposed project. The plan would contain a description of all nonhazardous solid and liquid construction wastes, recycling plans, and waste management methods to be used for each type of waste.

APM HAZ-7: Equipment and Vehicle Maintenance.

Southline or the applicable contractors would maintain all vehicles in good working order. Equipment would be properly tuned and maintained to avoid leaks of fluids.

APM HAZ-8: Refueling Procedures.

Service and refueling procedures would not be conducted within 500 feet of a seep, wash, or other water body.

8.3.6 Health and Human Safety and Electrical Characteristics

APM HEA-1: Worker Health and Safety and Environmental Training and Monitoring Program.

Prior to construction, Southline would conduct a worker health and safety, and environmental training program. As part of the program, Southline would develop and implement a health and safety plan (HASP). The HASP would address potential situations that workers could encounter during construction and maintenance. The HASP would require that first aid kits be stored in each construction vehicle and that a worker trained in first aid be included in each work group.

The purpose and goal of the worker safety and environmental training would be to communicate project-related environmental and safety concerns and appropriate work practices to all field and construction personnel prior to the start of construction, including spill prevention, emergency response measures, accident prevention, use of protective equipment, medical care of injured employees, safety education, and fire protection. Training would encompass environmental training related to road designations and speed limits, promote “good neighbor” policies, and institute BMPs for construction. The training would emphasize site-specific physical conditions to improve hazard prevention. It would include a review of all site-specific plans, including but not limited to the proposed project’s stormwater pollution prevention plan (SWPPP) and hazardous substances control and emergency response plans. Southline or the applicable contractors would also conduct health and safety training for O&M activities.

APM HEA-2: Notification of Utility Service Interruption.

Southline would locate overhead and underground utilities that may reasonably be expected to be encountered during construction. If a utility service interruption is known to be unavoidable, Southline would coordinate with the service provider to notify members of the public, the jurisdiction, and the service providers affected by the interruption via letters and newspapers notices published no later than 7 days prior to the first interruption. Copies of the notices would be provided to the BLM and Western following notification.

APM HEA-3: Fire Management Plan.

Southline would develop and implement a fire management plan for the proposed project.

APM HEA-4: Grounding.

All permanent metallic objects within the proposed project's transmission line ROWs would be grounded according to industry standards.

8.3.7 Noise

APM NOI-1: Compliance with Local Noise Ordinances.

Construction would comply with local noise ordinances. There may be a need to work outside the aforementioned local ordinances to perform work during available line outage windows in order to take advantage of low electrical draw periods during nighttime hours. The Applicant would comply with variance procedures required by local authorities.

APM NOI-2: Construction Equipment Maintenance.

Construction equipment would be maintained in good working order in accordance with manufacturer's recommendations.

APM NOI-3: Construction Equipment Idling Minimized.

Idling of construction equipment and vehicles would be minimized during construction.

APM NOI-4: Hearing Protection for Workers.

Workers would be provided appropriate hearing protection, if necessary, as described in the HASP.

8.3.8 Paleontology

APM PAL-1: Paleontological Resource Management Plan.

Prior to construction Southline would review existing paleontological literature and geologic maps to create a predictive model of where paleontological resources could exist along the proposed project. A qualified paleontologist would be retained by Southline to inspect areas along the proposed project that have a moderate to high potential to contain paleontological resources. This study would be coordinated with the BLM field offices and with Western. If areas are identified with a moderate to high probability to contain paleontological resources, a paleontological resource management and monitoring plan would be prepared for the proposed project.

APM PAL-2: Recovery, Testing, and Documentation.

If significant fossils are encountered during construction, construction activities would be temporarily diverted from the discovery and the monitor would notify all concerned parties, as well as collect matrix for testing, processing, and documentation, as directed by the project paleontologist.

8.3.9 Recreation

APM REC-1: Limit Construction Workspace in Wildlife and Recreational Areas.

Southline would not site additional workspace areas, such as contractor yards, in recreation areas in order to minimize impacts on recreational users during construction.

APM REC-2: Spur and Access Road Closure Signage.

Southline would coordinate with the BLM to display appropriate "closed" signage at the entrance to new spur roads to tower locations and access roads located on BLM-managed lands. This includes temporary signs during the construction phase of the proposed project and permanent signs and/or vehicle barriers that would close the spur routes to public travel.

APM REC-3: Recreation Area Closures.

If temporary short-term closures to recreational areas are necessary for construction activities, the Applicant would coordinate those closures with recreational facility owners. To the extent practicable, the Applicant would schedule construction activities to avoid heavy recreational use periods (e.g., holidays or tournaments). The Applicant would post notice of the closure onsite 14 calendar days prior to the closure.

8.3.10 Soils

APM SOIL-1: Topsoil Segregation.

As appropriate and feasible, Southline would implement topsoil segregation and conservation practices at substation sites and as directed by the BLM and Western. See APM VEG-2: Reclamation, Restoration, and Revegetation Plan.

8.3.11 Transportation

APM TRA-1: Traffic Control Plan.

Prior to the start of construction, Southline would prepare and implement a traffic control plan for the proposed project to address the timing and routing of project trips in an effort to minimize project impacts on local streets, highways, and railroad operations.

APM TRA-2: Helicopter Flight Plan and Safety Plan.

At least 60 days prior to first helicopter use on a transmission line segment, Southline would coordinate with the FAA for review and approval of plans for any helicopter flights that would take place during construction and operation. The Applicant would then provide information to the BLM and Western regarding the intended need and use of helicopters during construction and operation of the proposed project, including the flight and safety plan; the estimated number of days and hours that the helicopter would operate; the type and number of helicopters that would be used; the location, size, and number of staging areas for helicopter takeoffs and landings; and written approval from property owners for use of helicopter staging areas.

8.3.12 Vegetation

APM VEG-1: Minimize Vegetation Impacts.

Every effort would be made to minimize vegetation removal and permanent loss at construction sites to the extent practicable. Final tower and spur road locations would be selected to avoid sensitive vegetation to the greatest extent feasible.

APM VEG-2: Reclamation, Restoration, and Revegetation Plan.

Southline would develop a reclamation, restoration, and revegetation plan that would guide restoration and revegetation activities for all disturbed lands associated with construction of the proposed project and its eventual termination and decommissioning. The plan would address all Federal and private land disturbances. It would be developed in consultation with appropriate agencies and landowners, and would be provided to these entities for review and concurrence. The plan would provide details on topsoil segregation and conservation, vegetation treatment and removal, salvage of succulent species, revegetation methods, including use of native seed mixes, application rates, transplants, and criteria to monitor and evaluate revegetation success.

APM VEG-3: Special Status Plants Restoration and Compensation.

Special status plants, including the Pima pineapple cactus, would be restored by relocating plants and/or reseeding, replacing topsoil with existing topsoil that was removed, and regrading in compliance with local ordinances (Pima County) and/or measures in the biological opinion, if an Endangered Species Act (ESA) Section 7 consultation is required. Measures to restore special status plants would be implemented through the reclamation, restoration, and revegetation plan (APM VEG-2).

APM VEG-4: Vegetation Clearing.

Removal of riparian scrubland vegetation would be avoided where possible. Natural regeneration of native plants would be supported by cutting vegetation with hand tools, mowing, trimming, or using other removal methods that allow root systems to remain intact.

APM VEG-5: Invasive Plant Management Plan.

In consultation with local BLM field offices and local resource agencies, Southline would develop an invasive plant management plan.

APM VEG-6: Equipment Washing.

As feasible, equipment would be washed prior to entering, to minimize the potential for the spread of invasive species.

8.3.13 Visual Resources

APM VIS-1: Revegetation in Areas Disturbed by Construction.

In order to restore disturbed areas to an appearance that would blend back into the overall landscape, seeding and/or planting would be conducted 1) at road cuts where new roads are required to access new or existing transmission towers, and 2) in areas around new or rebuilt transmission structures that must be cleared during the construction process.

APM VIS-2: Use of Existing Access Roads and Road Modification.

To the extent feasible, existing access roads would be used. Widening and grading of roads would be kept to the minimum required for access by project construction equipment.

APM VIS-3: Dust Suppression.

During the construction period, dust suppression measures would be used to minimize the creation of dust clouds potentially associated with the use of access roads.

APM VIS-4: Use of Nonspecular Conductors.

The proposed project would incorporate nonspecular conductors into the project design to decrease reflectivity and visibility of project features.

8.3.14 Water Resources

APM WAT-1 Stormwater Pollution Prevention Plan.

A project-specific construction SWPPP would be prepared and implemented prior to the start of construction of the transmission line and substations in compliance with any Clean Water Act Section 404 permit terms and conditions, if required. The SWPPP would use BMPs to address the storage and handling of hazardous materials and sediment runoff during construction activities to minimize the risk of an accidental release. As a part of the SWPPP, soil disturbance at tower construction sites and access roads would be the minimum necessary for construction and designed to prevent long-term erosion through the following activities: restoration of disturbed soil, revegetation, and/or construction of permanent erosion control structures.

APM WAT-2: Avoid Stream and Active Drainage Channels.

Construction equipment would be kept out of flowing stream channels to the extent possible. Towers would be located to avoid active drainage channels, especially downstream of steep slope areas, to minimize the potential for damage by flash flooding and mud and debris flows.

APM WAT-3: Ditch and Drainage Design and Runoff Management.

Flood control devices would be located where required to protect towers or other project structures from flooding or erosion. Appropriate design of tower foundations would be used to prevent scour or inundation by a 100-year flood to avoid disturbed areas. The locations of transmission structures would be designed to avoid steep, disturbed, or otherwise unstable slopes. If drainages cannot be avoided by structure placement, Southline would design drainage crossings to accommodate estimated peak flows and ensure that natural volume capacity can be maintained throughout construction and upon post-construction restoration.

8.3.15 Wildlife

APM WILD-1: Worker Environmental Awareness Program.

A worker environmental awareness program (WEAP) would be prepared. All construction crews and contractors would be required to participate in WEAP training prior to starting work on the proposed project. The WEAP training would include a review of the special status species, waters of the United States, riparian habitat, cultural, paleontological, and other sensitive resources that could exist in the proposed project area, the locations of sensitive biological resources and their legal status and protections, and measures to be implemented for avoidance of these sensitive resources. A record of all trained personnel would be maintained during the construction period.

APM WILD-2: Biological Monitoring Plan.

In consultation with the BLM and Western, Southline would prepare a biological monitoring plan prior to construction that would specify the level of biological monitoring to be provided throughout construction activities in all construction zones with the potential for presence of sensitive biological resources. The number of monitors and monitoring frequency would be specified for each work zone.

APM WILD-3: Preconstruction Surveys.

Preconstruction surveys may be recommended in areas where Sonoran desert tortoise (now a separate species – Morafka's desert tortoise [*Gopherus morafkai*], also known as Sonoran desert tortoise) (*Gopherus morafkai*), Gila monster, and Tucson shovel-nosed snake are expected to occur. In consultation with the BLM and Western, Southline would hire qualified biologists to conduct preconstruction surveys in ground disturbance areas within potential habitat for appropriate special status species and their habitats.

APM WILD-4: Morafka's (aka Sonoran) Desert Tortoise Impact Reduction Measures.

To reduce impacts on the Sonoran (Morafka's) desert tortoise known to exist in the western portion of the proposed project area, only authorized biologists with a valid Arizona Game and Fish Department (AGFD) permit would handle desert tortoises if encountered within the proposed project area, following the most current desert tortoise handling guidelines published by the AGFD.

APM WILD-5: Migratory Birds and Raptors Impacts Reduction Measures.

To reduce impacts on migratory birds and raptors, especially near the Willcox Playa: 1) Southline would consult with the appropriate agencies (BLM or USFWS) on a case-by-case basis when active nests are found in project areas, unless directed to do otherwise by these same agencies; 2) active bird nests would not be moved during breeding season, in compliance with the Migratory Bird Treaty Act, unless the proposed project is expressly permitted to do so by the USFWS or BLM, depending on the location of the nest; 3) all active nests and disturbance or harm to active nests would be reported to the USFWS or BLM, upon detection; and 4) work would halt if it is determined that active nests would be disturbed by construction activities, until further direction or approval to work is obtained from the appropriate agencies.

Clearing, grubbing, blading, and access road improvements occurring within identified sensitive areas would be conducted outside of the breeding season for most desert-nesting migratory birds.

APM WILD-6: Avian Protection Plan, Bald and Golden Eagle Protection Act.

To reduce impacts on golden eagles and other raptors, Southline would submit an avian protection plan to the BLM and Western for approval. The plan would be prepared according to guidance provided by the USFWS (USFWS, 2010), and in consultation with best practices such as the *Suggested Practices for Avian Protection on Power Lines* (APLIC, 2006).

APM WILD-7: Western Burrowing Owl Guidelines.

Southline would follow Pima County guidelines for surveys prior to disturbance in priority conservation areas for western burrowing owls.

APM WILD-8: Facility Siting.

Final tower and spur road locations would be adjusted to avoid sensitive wildlife resources to the greatest extent feasible.

APM MIL-1: Airspace Usage Notification.

The appropriate military scheduler(s) and U.S. Border Patrol representative(s) would be contacted to schedule airspace usage for any construction or maintenance activity on lands that could be used by the military and/or U.S. Border Patrol for training activities or other flights. Coordination would occur with the applicable scheduling office to schedule necessary airspace usage prior to maintenance activities.

APM MIL-2: Federal Aviation Administration (FAA) Compliance.

The proposed project would 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.

Additional Mitigation Proposed by the Arizona Air National Guard.

The following mitigation measures relevant to military operations have been recommended by the Arizona Air National Guard (ANG), 162nd Fighter Wing (FW) Airspace Manager.

- Lower the transmission lines in areas intersecting MTRs 259, 260, and 263 to remove impacts to military training and airspace usage. Additionally, do not erect any structures exceeding 200 feet in height.
- Chart the transmission lines before they are erected.
- Identify transmission structures with high-visibility markers in areas where they intersect or parallel MTRs.

Appendix A
Transmission Line Construction Crews – Anticipated Size, Duration, and Equipment Utilization

Table A-1 contains detail on the type of crews, number of crews, crew sizes, crew productivity rates, minimum duration of crew activities, and equipment utilization anticipated for transmission line construction on the proposed project.

TABLE A-1: TRANSMISSION LINE CONSTRUCTION CREWS – ANTICIPATED SIZE, DURATION, AND EQUIPMENT UTILIZATION

345 kV Double Circuit Lattice Towers (New ROW)

Line length (miles)	240
Structures per mile	4.5
Work-days per month	24

230 kV Double Circuit Tubular Steel (Upgrade of 115 kV H-frame)

Line length (miles)	120
Structures per mile	5.5
Work-days per month	24

							Hours of Equipment Utilization (w/engines on) per Crew-Day																					
Crew Type	**Crew Size (Men)**	**% of Crew Hired Locally**	**No. of Crews**	**Structs. per Crew-Day**	**Crew Days per Mile**	**Min* Activity Duration (Months)**	**Pick-up truck**	**2-ton truck**	**Flatbed w/boom**	**Light crane**	**Heavy crane**	**Motor grader**	**Bulldozer**	**Front-end loader**	**Dump truck**	**Water truck**	**Auger**	**Concrete Truck**	**Forklift**	**Drum puller**	**Tensioner**	**Splicing truck**	**Tractor**	**ATV**		
345 kV Double Circuit Lattice Towers (New ROW)																												
Project Administration	15	25%	1	(n/a)	2.4	24.0	10																			
ROW Survey	4	75%	2	(n/a)	0.4	2.0	3																	3		
Geotechnical Investigations	3	50%	1	(n/a)	0.5	5.0	4										5									
Access Road Construction	4	75%	2	(n/a)	2.0	10.0	5					4	4	4	6	6										
Foundation Installation	12	50%	3	1.0	4.5	15.0	3	6	3					2		2	8	8								
Staging Area / Receiving	5	50%	3	(n/a)	7.2	24.0	2			1									4							
Structure Hauling	5	25%	2	1.5	3.0	15.0	5	6											3							
Structure Assembly	18	25%	6	0.4	11.3	18.8	3		4	6									2							
Structure Erection	18	25%	3	1.3	3.5	11.5	6			6	6															
Wire Stringing (double circuit)	40	25%	3	(n/a)	2.8	9.3	10	4	4										4	8	8	2	2			
Road/ROW Restoration	6	75%	1	(n/a)	0.5	5.0	4					6	6			4							6			
Clean-up	4	75%	1	(n/a)	0.2	2.0	6							6	6											
230 kV Double Circuit Tubular Steel (Upgrade of 115 kV H-frame)																												
Project Administration	15	25%	1	(n/a)	2.4	24.0	10																			
ROW Survey	4	75%	1	(n/a)	0.4	2.0	3																	3		
Geotechnical Investigations	3	50%	1	(n/a)	0.5	2.5	4										5									
Access Road Construction	4	75%	1	(n/a)	2.0	10.0	5					4	4	4	6	6										
Foundation Installation	10	50%	3	1.0	6.0	10.0	3	6	3					2		2	8	10								
Staging Area / Receiving	4	50%	2	(n/a)	9.6	24.0	2			1									4							
Structure Hauling	5	25%	1	3.0	1.8	9.2	5	6	2										3							
Structure Framing	8	25%	1	4.0	1.4	6.9	3		4	6									2							
Structure Erection	15	25%	1	2.0	2.8	13.8	6				8															
Wire Stringing (double circuit)	40	25%	2	(n/a)	2.8	7.0	10	4	4										4	8	8	2	2			
Road/ROW Restoration	6	75%	1	(n/a)	0.5	2.5	4					6	6			4							6			
Clean-up	4	75%	1	(n/a)	0.2	1.0	6							6	6											

* Minimum duration assumes all crews for an activity operate concurrently; Total duration will likely be longer as the number of crews ramps up at the beginning and ramps down at the end.

Appendix B
Substation Construction Crews – Anticipated Size, Duration, and Equipment Utilization

Tables B-1, B-2, B-3, and B-4 contains detail on component quantities, the type of crews, number of crews, crew sizes, crew productivity rates, minimum duration of crew activities, and equipment utilization anticipated for substation construction on the proposed project.

TABLE B-1: SUBSTATION CONSTRUCTION CREWS – ANTICIPATED SIZE AND DURATION

24 Man-Days per Month	**Afton**	**Midpoint**	**Hidalgo**	**Apache**	**Adams Tap**	**Pantano**	**Vail**	**Nogales**	**Del Bac**	**DMP**	**Tucson**	**Rattlesnake**	**Marana**	**Saguaro**	**Tortolita**
Sitework (Grading, Fencing, Rocking)															
Crew Days (5-man crews)	45	54	54	54	27	27	45	54	18	27	36	27	27	45	27
Crew Months	1.9	2.3	2.3	2.3	1.1	1.1	1.9	2.3	0.8	1.1	1.5	1.1	1.1	1.9	1.1
No. of Crews	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Months	1.9	2.3	2.3	2.3	1.1	1.1	1.9	2.3	0.8	1.1	1.5	1.1	1.1	1.9	1.1
Electricians (Conduit, Ground Grid, Wiring)															
Crew Days (5-man crews)	72	72	90	144	54	54	54	63	36	54	54	54	54	45	54
Crew Months	3.0	3.0	3.8	6.0	2.3	2.3	2.3	2.6	1.5	2.3	2.3	2.3	2.3	1.9	2.3
No. of Crews	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total Months	3.0	3.0	3.8	6.0	2.3	2.3	2.3	2.6	1.5	2.3	2.3	2.3	2.3	1.9	2.3
Foundations															
Crew Days (5-man crews)	232	282	388	395	60	33	149	102	51	86	131	66	68	78	77
Crew Months	9.7	11.7	16.2	16.5	2.5	1.4	6.2	4.3	2.1	3.6	5.5	2.8	2.9	3.2	3.2
No. of Crews	2	2	3	3	2	1	2	2	1	2	2	2	2	2	2
Total Months	4.8	5.9	5.4	5.5	1.2	1.4	3.1	2.1	2.1	1.8	2.7	1.4	1.4	1.6	1.6
Above Grade (Steel,Bus, Equipment)															
Crew Days (5-man crews)	214	258	355	573	65	41	129	104	60	94	118	74	73	81	73
Crew Months	8.9	10.8	14.8	23.9	2.7	1.7	5.4	4.4	2.5	3.9	4.9	3.1	3.0	3.4	3.0
No. of Crews	2	2	2	3	1	1	2	2	1	2	2	1	1	1	1
Total Months	4.5	5.4	7.4	8.0	2.7	1.7	2.7	2.2	2.5	2.0	2.5	3.1	3.0	3.4	3.0
Anticipated Total Duration (months)	11	12	13	15	5	4	6	6	4.5	4.5	6.5	5	5	6	5

TABLE B-2: SUBSTATIONS – ANTICIPATED COMPONENT QUANTITIES

	Substation Quantities															
Equipment	Total	Afton	Midpoint	Hidalgo	Apache	Adams Tap	Pantano	Vail	Nogales	Del Bac	DMP	Tucson	Rattlesnake	Marana	Saguaro	Tortolita
500kV Circuit Breaker	2															2
345kV Circuit Breaker	39	8	6	13	9			3								
230kV Circuit Breaker	52				9	3	2	6	6	2	3	9	3	3	3	3
115kV Circuit Breaker	3										2				1	
500kV Disconnect Switch	4															4
345kV Disconnect Switch	128	26	30	40	26			6								
230kV Disconnect Switch	126				18	6	4	12	14	8	10	18	10	10	10	6
115kV Disconnect Switch	6										4				2	
345kV Metering Unit	66	18	18	18	12											
230kV Metering Unit	78				12	6	6	6	6	6	3	15	6	6	3	3
345kV Arrester	42	12	12	12	6											
230kV Arrester	72				6	6	6	6	6	6	3	15	6	6	3	3
345kV Phase Shifter Transformer	2	2														
500/230kV 598 MVA Transformer	1															1
345/230kV 650 MVA Transformer	2				2											
230/115kV 300 MVA Transformer	4					1						1	1	1		
345/230kV 720 MVA Transformer	2							2								
230/115kV 615 MVA Transformer	3								1		2					
230/115kV 462 MVA Transformer	2														2	
345kV Shunt Capacitor (50 MVAR)	4			2					2							
345kV Shunt Capacitor (100 MVAR)	1			1												
345kV Shunt Capacitor (25 MVAR)	2			2												
345kV Series Cap Bank (123 MVAR)	4	2	2													
345kV Series Cap Bank (147 MVAR)	4			2	2											
345kV Series Cap Bank (159 MVAR)	4		2	2												
345kV Line Reactor (111 MVAR)	4	2	2													
345kV Line Reactor (134 MVAR)	4			2	2											
345kV Line Reactor (144 MVAR)	4		2	2												
345kV Shunt Reactor (50 MVAR)	2				2											
345kV SVC (-50/+250 MVAR)	1				1											
500kV Bus Supports	3															3
345kV Bus Supports	537	87	138	192	102			18								
230kV Bus Supports	399				42	27	12	24	57	45	36	54	36	36	12	18
115kV Bus Supports	39								3		18		9		9	
500kV Deadend	1															1
345kV Deadend	61	12	16	18	10			5								
230kV Deadend	38				6	3	2	4	2	2	2	7	2	3	3	2
115kV Deadend	1														1	

TABLE B-3: SUBSTATION CONSTRUCTION CREWS – ANTICIPATED EQUIPMENT UTILIZATION BY COMPONENT

	Crew-Days Required (Assume 5-Man Crews)		Hours of Equipment Utilization (w/engines on) per Piece of Equipment									
			Foundations					Equipment Installation				
Equipment	Foundations	Equipment	Excavator	Drill Rig	Forklift	Concrete Truck	Pick-Up	Forklift	Boom Truck	Man-Lift	Crane	Pick-Up
500kV Circuit Breaker	3.5	1.2	8.0		25.0	4.5	7.0	5.0		5.0		2.0
345kV Circuit Breaker	3	1	5.0		25.0	3.5	6.0	5.0		5.0		2.0
230kV Circuit Breaker	3	1	5.0		25.0	3.0	6.0	5.0		5.0		2.0
115kV Circuit Breaker	3	1	5.0		25.0	2.5	6.0	5.0		5.0		2.0
500kV Disconnect Switch (6 fdns)	2.4	0.75		9.0	27.0	6.0	5.0	12.0	18.0	21.0		1.5
345kV Disconnect Switch (4 fdns)	1.4	0.75		4.0	14.0	4.0	3.0	6.0	10.0	12.0		1.5
230kV Disconnect Switch (4 fdns)	1.4	0.5		4.0	12.0	3.5	3.0	4.0	8.0	10.0		1.0
115kV Disconnect Switch (2 fdns)	0.7	0.5		2.0	6.0	1.5	2.0	2.0	4.0	5.0		1.0
345kV Metering Unit	0.35	0.25		1.0	3.5	0.9	1.0	1.0	2.0	2.5		0.5
230kV Metering Unit	0.35	0.25		1.0	3.0	0.8	1.0	1.0	2.0	2.5		0.5
345kV Arrester	0.35	0.25		1.0	3.0	0.9	1.0	1.0	2.0	2.5		0.5
230kV Arrester	0.35	0.25		1.0	3.0	0.8	1.0	1.0	2.0	2.5		0.5
345kV Phase Shifter Transformer	12	7	10.0		70.0	10.0	24.0			5.0	15.0	14.0
500/230kV 598 MVA Transformer	12	7	10.0		70.0	5.0	24.0			5.0	15.0	14.0
345/230kV 650 MVA Transformer	12	7	10.0		70.0	5.0	24.0			5.0	15.0	14.0
230/115kV 300 MVA Transformer	10	6	10.0		70.0	3.5	20.0			5.0	10.0	12.0
345/230kV 720 MVA Transformer	12	7	10.0		70.0	5.0	24.0			5.0	15.0	14.0
230/115kV 615 MVA Transformer	10	6	10.0		70.0	5.0	20.0			5.0	10.0	12.0
230/115kV 462 MVA Transformer	10	6	10.0		70.0	3.5	20.0			5.0	10.0	12.0
345kV Shunt Capacitor (50 MVAR)	8	4	20.0		10.0	3.5	16.0	5.0	20.0	15.0		8.0
345kV Shunt Capacitor (100 MVAR)	8	4	20.0		10.0	5.0	16.0	5.0	20.0	15.0		8.0
345kV Shunt Capacitor (25 MVAR)	8	4	20.0		10.0	2.5	16.0	5.0	20.0	15.0		8.0
345kV Series Cap Bank (123 MVAR)	8	4	20.0		10.0	5.0	16.0	5.0	20.0	15.0		8.0
345kV Series Cap Bank (147 MVAR)	8	4	20.0		10.0	5.0	16.0	5.0	20.0	15.0		8.0
345kV Series Cap Bank (159 MVAR)	8	4	20.0		10.0	5.0	16.0	5.0	20.0	15.0		8.0
345kV Line Reactor (111 MVAR)	8	4	20.0		10.0	5.0	16.0	5.0	20.0	15.0		8.0
345kV Line Reactor (134 MVAR)	8	4	20.0		10.0	5.0	16.0	5.0	20.0	15.0		8.0
345kV Line Reactor (144 MVAR)	8	4	20.0		10.0	5.0	16.0	5.0	20.0	15.0		8.0
345kV Shunt Reactor (50 MVAR)	8	4	20.0		10.0	3.5	16.0	5.0	20.0	15.0		8.0
345kV SVC (-50/+250 MVAR)	50	150	150.0	140.0	300.0	50.0	100.0	500.0	200.0	500.0	20.0	300.0
500kV Bus Supports	0.4	0.5		1.5	4.5	1.0	0.8	2.0	3.0	3.5		1.0
345kV Bus Supports	0.35	0.3		1.0	3.5	1.0	0.7	1.5	2.5	3.0		0.5
230kV Bus Supports	0.35	0.25		1.0	3.0	0.9	0.7	1.0	2.0	2.5		0.5
115kV Bus Supports	0.35	0.25		1.0	3.0	0.8	0.7	1.0	2.0	2.5		0.5
500kV Deadend (A-frame)	8	1.5		20.0	72.0	6.0	16.0		15.0	15.0		3.0
345kV Deadend (A-frame)	6	1.5		12.0	56.0	5.0	12.0		15.0	15.0		3.0
230kV Deadend (A-frame)	5.2	1.5		10.0	44.0	3.5	11.0		15.0	15.0		3.0
115kV Deadend (A-frame)	2.2	1.5		10.0	44.0	2.5	5.0		15.0	15.0		3.0
Control Building	3	10		20.0	15.0	5.0	6.0	20.0			10.0	20.0

TABLE B-4: SUBSTATION CONSTRUCTION CREWS – ANTICIPATED EQUIPMENT UTILIZATION BY CREW

	Equipment Utilization (% of Crew Time)
Sitework (Grading, Fencing, Rocking)	
Bulldozer	30%
Front End Loader	30%
Dump Truck	30%
Excavator	20%
Grader	10%
Pick-Up Truck	20%
Electricians (Conduit, Ground Grid, Wiring)	
Front End Loader	20%
Excavator	15%
Pick-Up Truck	20%
Foundations	
Excavator	7%
Drill Rig	18%
Forklift	77%
Ready-Mix Truck	15%
Pick-Up Truck	20%
Above Grade (Steel,Bus, Equipment)	
Forklift	34%
Boom Truck	65%
Man-Lift	77%
Crane	3%
Pick-Up Truck	20%

Appendix C
Staging Areas

Transmission line staging areas would be required across the proposed project at intervals of approximately 10-25 miles depending on terrain and accessibility of the right-of-way in between the staging areas. The staging areas would be used to:

1. Provide a show-up location and parking area for laborers. Typically the laborers would drive their personal vehicles to the staging area closest to the line segment they are working on that day. Crews are typically loaded into vans and transported to the specific structure locations.
2. Provide a base of operations for construction management. The construction contractor would typically have construction trailers at each staging area in which the project documents are maintained and where meetings can be held.
3. Provide a storage location for materials. Typically the material suppliers are responsible for delivery from the factory to the staging areas. As work progresses down line, the construction crews move the materials out of the staging areas to specific sites.
4. Provide a location for fuel storage, water storage, and for equipment maintenance activities.
5. Provide storage of equipment that cannot be left on the right-of-way overnight.

Preliminary locations for staging areas have been identified. No landowners have been contacted so it is very possible that some would need to be relocated. The reasoning used to site staging areas on the proposed project was as follows:

1. Staging areas should be located about 20 miles apart in open lands with decent access. They should be spaced closer to 10 miles apart in congested areas where heavy local traffic can impact operations. They should also be spaced closer in areas with difficult terrain.
2. A staging area needs to have good access to public roads so that truck drivers unfamiliar with the project can find it easily. Ideally it would be located close to the project right-of-way as well. However, when the right-of-way is a long distance from a good paved road, it usually makes more sense to locate it away from the right-of-way.
3. It is preferable to locate them close to public facilities that would be frequented by the laborers (i.e. gas stations, restaurants, hotels, etc.)

Table C-1 identifies the staging areas applicable to the proposed New Build Section and to the Upgrade Section. It also identifies staging area additions and deletions from the proposed project associated with the various alternatives.

TABLE C-1: STAGING AREAS – ANTICIPATED NEED BY ALTERNATIVE

	Staging Area Designations		
Line Segment or Path	Original	Additions	Deletions
Proposed New Build (P1-P8)	**1, 2, 3, 4, 5, 6, 7, 8, 9**	**6a**	-
Alt. Southern Route (S1-S8)	S1, S2, S3, S4, S5, S6, S7, S8	-	1, 2, 3, 4, 5
Alt. A	-	-	-
Alt. B	-	-	-
Alt. C	-	-	-
Alt. D	-	D	S8
Alt. E	-	E	7
Alt. F	-	F	8
Alt. G	-	Ga, Gb	9
Alt. I	-	-	-
Alt. J	-	-	-
Alt. LD-1	-	LD1a, LD1b	6a, 7
Alt. LD-2	-	-	-
Alt. LD-3	-	LD3	6
Alt. WC-1	-	WC1, Gb	9
Proposed Upgrade (U1-U4)	**10, 11, 12, 13, 14**	**12a, 13a**	-
Alt. H	-	-	-
Alt. BE-2	-	Gb	-
Alt. TH-1	-	-	-
Alt. TH-2	-	-	-
Alt. TH-3	-	-	-
Alt. MA-1	-	-	-

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Appendix D
Access Roads – Characterization and Disturbance Estimates

Access Road Types

The access road plan for the Southline Transmission Project assumes that four primary types of access would be utilized:

- Access Type A – Access from adequate private roads. This type of access would be used when there is no existing road adjacent and parallel to the alignment but where this is an existing patchwork of roads in the area that could be used to get close to the structure locations. Spur roads would usually be graded between the existing roads and each structure location. Depending on land usage, overland "drive and crush" might be used in lieu of a graded spur road. This is the normal type of access used in densely populated areas and in active agricultural lands. Except in rare cases, the existing roads would not be upgraded.
- Access Type B – Parallel to maintained public roads. This type of access would be used when the alignment roughly parallels a nearby public road that is either paved or has gravel surfacing. Spur roads would be graded between the existing roads and each structure location. Except in rare cases, the existing roads would not be upgraded.
- Access Type C – Parallel to existing utility roads. This type of access would be used when the alignment roughly parallels an existing utility that already has a dirt access road. Spur roads would be graded between the existing utility roads and each structure location. Typically the existing utility roads would be upgraded. At a minimum it is anticipated a road grader would be used to ensure a smooth surface for construction. Roads with a travel surface less than 12 feet in width would be widened to approximately 12 feet. Typically the overall disturbance would be limited to 16 feet (approximately two feet either side of the road surface).
- Access Type D – Needs new down-line primary access. This type of access would only be used when one of the other three types is not feasible. It would consist of a 16-foot wide road (12-foot travel surface plus 2 feet each side for berms/ditches). Except in rare cases, the new access would be contained entirely within the Southline right-of-way. Typically, new down-line access would be used if any parallel roads are more than 700 feet from the alignment. This access type would normally be used for alignments that parallel interstate highways and railroads since the owners of those facilities typically place restrictions on the usage of their facilities that doesn't allow for the addition of spur roads.

Access Road Permanent Disturbance Estimates

Tables D-1, D2, D3, and D4 characterize the type of access anticipated by segment along with estimated levels of permanent disturbance. Google Earth was used to collect the following data:

- The total length of each segment.
- Approximate sub-segment lengths applicable to each of the four access road types. This data was converted to an approximate percentage of the total segment length for use in the spreadsheet.
- Average lengths of required spur roads.
- Average widths of existing parallel utility roads.
- Apparent need for upgrading existing roads. If it appears that the adjacent road is in need of upgrading, then that sub-segment was automatically defined as Type C access.

Google Earth was also used to assess the terrain for each segment in order to come up with an access road length modifier to estimate the total length of parallel/down-line access roads relative to the corridor length.

The tables use the following assumptions in calculating the level of disturbance:

- All 345-kV segments utilize a 200-foot right-of-way with 4.5 structures per mile.
- All 230-kV segments utilize a 150-foot right-of-way with 5.5 structures per mile.
- All existing parallel access is outside the Southline right-of-way.
- All new down-line access is within the Southline right-of-way.
- Spur roads are outside the Southline right-of-way except for the first 100 feet on 345-kV segments and the first 75 feet on 230-kV segments.
- The total width of spur roads including berms and ditches is assumed to be 12 feet.

Access Road Temporary Disturbance Estimates

Additional temporary spur roads would be required for stringing and splicing sites with Access Types A, B, and C. In most cases, "drive and crush" would be used to these sites in lieu of blading a new spur road. It is anticipated that an average of one new spur road per mile would be required, and that the total width of disturbance would be approximately 10 feet. This equates to less than 0.1 acres per mile of additional temporary disturbance for access roads.

TABLE D-1: ACCESS ROAD CHARACTERIZATION AND DISTURBANCE ESTIMATES – PROPOSED NEW BUILD SEGMENTS

	Proposed 345 kV Alignment													
Segment Designation	**P1**	**P2**	**P3**	**P4a**	**P4b**	**P4c**	**P5a**	**P5b**	**P6a**	**P6b**	**P6c**	**P7**	**P8**	***Est. Miles***
Approximate Segment Length (mi.)	5.1	102.0	31.1	9.0	13.8	1.8	9.6	21.1	0.9	22.4	2.8	22.3	0.4	*242.3*
Longitudinal Access Road Length Modifier due to Terrain	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.04	1.03	1.03	1.03	1.03	1.02	*248.1*
Land Use														
Barren	100%	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		*236.8*
Rural/Industrial		5%											100%	*5.5*
Residential														*0.0*
Primary Access Roads														
Access Type A - Access from adequate private roads		5%											100%	*5.5*
Access Type B - Parallel to maintained public roads												2%		*0.4*
Access Type C - Parallel to existing utility roads		95%		100%			100%	100%	100%	94%	100%	98%		*183.2*
Access Type D - Needs new downline primary access	100%		100%		100%	100%				6%				*53.1*
Access Type A - Access from adequate private roads														
Approximate alignment length (mi)	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	*5.6*
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
Average length of spur roads (ft)		300											100	
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	
New disturbance (acres)	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
Access Type B - Parallel to maintained public roads														
Approximate alignment length (mi)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	*0.5*
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
Average length of spur roads (ft)												150		
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	
New disturbance (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	
Access Type C - Parallel to existing utility roads														
Approximate alignment length (mi)	0.0	98.8	0.0	9.2	0.0	0.0	9.8	21.9	0.9	21.7	2.9	22.5	0.0	*187.8*
Average width of existing utility roads (ft)		9		9			9	10	10	10	9	10		
Proposed width of upgraded utility roads (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	
Percent of existing utility roads needing upgrades	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	
Average length of spur roads (ft)		300		250			200	150	150	150	150	200		
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	
Disturbance to areas disturbed previously (acres)	0.0	107.8	0.0	10.0	0.0	0.0	10.7	26.6	1.1	26.3	3.1	27.3	0.0	
New disturbance (acres)	0.0	120.6	0.0	10.6	0.0	0.0	10.7	20.0	0.8	19.8	3.0	22.0	0.0	
Access Type D - Needs new downline primary access														
Approximate alignment length (mi)	5.2	0.0	31.7	0.0	14.1	1.9	0.0	0.0	0.0	1.4	0.0	0.0	0.0	*54.2*
Proposed width of new primary access road (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	
New disturbance (acres)	10.1	0.0	61.5	0.0	27.3	3.6	0.0	0.0	0.0	2.7	0.0	0.0	0.0	
Total disturbance to areas disturbed previously (acres)	0.0	107.8	0.0	10.0	0.0	0.0	10.7	26.6	1.1	26.3	3.1	27.3	0.0	*213.0*
Total new disturbance (acres)	10.1	122.6	61.5	10.6	27.3	3.6	10.7	20.0	0.8	22.5	3.0	22.0	0.1	*314.9*
New distubance per mile (acres/mile)	1.98	1.20	1.98	1.18	1.98	2.00	1.12	0.95	0.94	1.00	1.07	0.99	0.13	*1.30*
Total new disturbance within Southline ROW (acres)	10.1	12.9	61.5	1.1	27.3	3.6	1.2	2.7	0.1	5.4	0.4	2.8	0.1	*129.2*
Total new disturbance outside Southline ROW (acres)	10.1	109.7	0.0	9.5	0.0	0.0	9.5	17.3	0.7	17.1	2.6	19.2	0.0	*195.7*
Total length of permanent access roads (miles):														
Existing - No improvement necessary (~parallels ROW	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.4	6.1
Existing - Improvement required (~parallels ROW)	0.0	98.8	0.0	9.2	0.0	0.0	9.8	21.9	0.9	21.7	2.9	22.5	0.0	187.8
New longitudinal roads within Southline ROW	5.2	0.0	31.7	0.0	14.1	1.9	0.0	0.0	0.0	1.4	0.0	0.0	0.0	54.2
New spur roads within Southline ROW	0.0	8.9	0.0	0.8	0.0	0.0	0.8	1.9	0.1	1.8	0.2	2.0	0.0	16.5
New spur roads outside ROW but inside 2 mi. corridor	0.0	17.7	0.0	1.2	0.0	0.0	0.8	0.9	0.0	0.9	0.1	1.9	0.0	23.7

TABLE D-2: ACCESS ROAD CHARACTERIZATION AND DISTURBANCE ESTIMATES – PROPOSED UPGRADE SEGMENTS

	Proposed 230 kV Alignment																	
Segment Designation	**U1a**	**U1b**	**U2**	**U3a**	**U3b**	**U3c**	**U3d**	**U3e**	**U3f**	**U3g**	**U3h**	**U3i**	**U3j**	**U3k**	**U3l**	**U3m**	**U4**	***Est. Miles***
Approximate Segment Length (mi.)	16.1	2.9	15.8	35.6	0.5	1.0	3.4	0.9	0.7	0.9	1.1	18.2	0.9	16.7	1.5	0.3	1.9	*118.4*
Longitudinal Access Road Length Modifier due to Terrain	1.03	1.03	1.03	1.05	1.03	1.03	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	*122.3*
Land Use																		
Barren	60%	100%	40%	60%										15%	30%		100%	*45.1*
Rural/Industrial	40%		55%	30%	100%	30%	50%	100%	100%			70%	100%	85%	70%	100%		*59.1*
Residential			5%	10%		70%	50%			100%	100%	30%						*14.2*
Primary Access Roads																		
Access Type A - Access from adequate private roads	20%		15%	5%	100%	100%	25%			100%	100%	30%	100%	35%	70%	100%		*25.3*
Access Type B - Parallel to maintained public roads							30%					30%		10%				*8.2*
Access Type C - Parallel to existing utility roads	80%	100%	85%	95%			45%	100%	100%			40%		55%			100%	*84.5*
Access Type D - Needs new downline primary access															30%			*0.5*
Access Type A - Access from adequate private roads																		
Approximate alignment length (mi)	3.3	0.0	2.4	1.9	0.5	1.0	0.9	0.0	0.0	0.9	1.1	5.6	0.9	6.0	1.1	0.3	0.0	*25.9*
Average number of new spur roads per mile	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
Average length of spur roads (ft)	400		300	100	150	200	200			100	100	100	300	300	300	200		
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
New disturbance (acres)	2.0	0.0	1.1	0.3	0.1	0.3	0.3	0.0	0.0	0.1	0.2	0.8	0.4	2.7	0.5	0.1	0.0	
Access Type B - Parallel to maintained public roads																		
Approximate alignment length (mi)	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	5.6	0.0	1.7	0.0	0.0	0.0	*8.3*
Average number of new spur roads per mile	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
Average length of spur roads (ft)						100	100					100		300				
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
New disturbance (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.8	0.0	0.8	0.0	0.0	0.0	
Access Type C - Parallel to existing utility roads																		
Approximate alignment length (mi)	13.3	3.0	13.8	35.5	0.0	0.0	1.6	0.9	0.7	0.0	0.0	7.4	0.0	9.4	0.0	0.0	1.9	*87.6*
Average width of existing utility roads (ft)	10	9	9	10			10	10	10			9		9			12	
Proposed width of upgraded utility roads (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
Percent of existing utility roads needing upgrades	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Average number of new spur roads per mile	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
Average length of spur roads (ft)	100	50	50	100			100	50	50			50		50			250	
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
Disturbance to areas disturbed previously (acres)	16.1	3.3	15.1	43.0	0.0	0.0	1.9	1.1	0.9	0.0	0.0	8.1	0.0	10.2	0.0	0.0	2.8	
New disturbance (acres)	11.7	2.8	12.8	31.2	0.0	0.0	1.4	0.7	0.6	0.0	0.0	6.9	0.0	8.7	0.0	0.0	1.7	
Access Type D - Needs new downline primary access																		
Approximate alignment length (mi)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	*0.5*
Proposed width of new primary access road (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
New disturbance (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	
Total disturbance to areas disturbed previously (acres)	16.1	3.3	15.1	43.0	0.0	0.0	1.9	1.1	0.9	0.0	0.0	8.1	0.0	10.2	0.0	0.0	2.8	*102.5*
Total new disturbance (acres)	13.7	2.8	13.9	31.5	0.1	0.3	1.8	0.7	0.6	0.1	0.2	8.6	0.4	12.1	1.4	0.1	1.7	*90.0*
New distubance per mile (acres/mile)	0.85	0.95	0.88	0.88	0.23	0.31	0.54	0.83	0.83	0.16	0.15	0.47	0.46	0.73	0.92	0.31	0.88	*0.76*
Total new disturbance within Southline ROW (acres)	1.9	0.3	1.8	4.2	0.1	0.1	0.4	0.1	0.1	0.1	0.1	2.1	0.1	1.9	1.0	0.0	0.2	*14.7*
Total new disturbance outside Southline ROW (acres)	11.8	2.4	12.0	27.2	0.1	0.2	1.4	0.6	0.5	0.0	0.0	6.4	0.3	10.2	0.4	0.1	1.5	*75.2*
Total length of permanent access roads (miles):																		
Existing - No improvement necessary (~parallels ROW	3.3	0.0	2.4	1.9	0.5	1.0	1.9	0.0	0.0	0.9	1.1	11.1	0.9	7.7	1.1	0.3	0.0	34.3
Existing - Improvement required (~parallels ROW)	13.3	3.0	13.8	35.5	0.0	0.0	1.6	0.9	0.7	0.0	0.0	7.4	0.0	9.4	0.0	0.0	1.9	87.6
New longitudinal roads within Southline ROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5
New spur roads within Southline ROW	1.3	0.2	0.9	2.9	0.0	0.1	0.3	0.0	0.0	0.1	0.1	1.3	0.1	1.1	0.1	0.0	0.2	8.6
New spur roads outside ROW but inside 2 mi. corridor	1.5	0.0	0.6	1.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.3	0.2	1.8	0.3	0.0	0.4	6.4

TABLE D-3: ACCESS ROAD CHARACTERIZATION AND DISTURBANCE ESTIMATES – ALTERNATIVE SEGMENTS

	Alternative Alignments																			
Segment Designation	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**A**	**B**	**C**	**D**	**E**	**F**	**Ga**	**Gb**	**Gc**	**H**	**I**	**J**
Approximate Segment Length (mi.)	13.4	11.0	12.9	10.5	29.8	7.4	41.6	14.5	17.4	12.1	8.9	22.7	31.6	25.2	25.6	1.1	7.4	19.2	2.3	2.3
Longitudinal Access Road Length Modifier due to Terrain	1.02	1.03	1.02	1.03	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.02	1.02	1.02	1.02	1.05	1.03	1.03
Land Use																				
Barren	100%	100%	100%	100%	65%	80%	100%	85%	100%	100%	95%	85%	85%	75%	60%	100%	40%	90%	100%	100%
Rural/Industrial					35%	20%		15%			5%	15%	15%	25%	40%		60%	10%		
Residential																				
Primary Access Roads																				
Access Type A - Access from adequate private roads					10%	20%							10%	25%	15%	20%	10%			
Access Type B - Parallel to maintained public roads			100%		55%		50%		50%	100%	85%				5%		50%			
Access Type C - Parallel to existing utility roads	70%						15%		50%	0%		50%		25%	40%		40%	95%		100%
Access Type D - Needs new downline primary access	30%	100%		100%	35%	80%	35%	100%			15%	50%	90%	50%	40%	80%		5%	100%	
Access Type A - Access from adequate private roads																				
Approximate alignment length (mi)	0.0	0.0	0.0	0.0	3.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	3.3	6.4	3.9	0.2	0.8	0.0	0.0	0.0
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.5	4.5	4.5
Average length of spur roads (ft)					200	300							400	200	200	200	200			
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
New disturbance (acres)	0.0	0.0	0.0	0.0	0.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0	1.6	1.6	1.0	0.1	0.2	0.0	0.0	0.0
Access Type B - Parallel to maintained public roads																				
Approximate alignment length (mi)	0.0	0.0	13.2	0.0	16.7	0.0	21.2	0.0	8.9	12.3	7.7	0.0	0.0	0.0	1.3	0.0	3.8	0.0	0.0	0.0
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.5	4.5	4.5
Average length of spur roads (ft)			450		300		350		450	400	300				150		200			
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
New disturbance (acres)	0.0	0.0	7.3	0.0	6.2	0.0	9.2	0.0	5.0	6.1	2.9	0.0	0.0	0.0	0.2	0.0	0.9	0.0	0.0	0.0
Access Type C - Parallel to existing utility roads																				
Approximate alignment length (mi)	9.6	0.0	0.0	0.0	0.0	0.0	6.4	0.0	8.9	0.0	0.0	11.7	0.0	6.4	10.4	0.0	3.0	19.2	0.0	2.4
Average width of existing utility roads (ft)	12						8		8			12		12	9		9	10		8
Proposed width of upgraded utility roads (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Percent of existing utility roads needing upgrades	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	25%	100%	100%	100%	100%	100%	100%
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.5	4.5	4.5
Average length of spur roads (ft)	150						200		100			50		200	100		150	300		200
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Disturbance to areas disturbed previously (acres)	13.9	0.0	0.0	0.0	0.0	0.0	6.2	0.0	8.6	0.0	0.0	17.0	0.0	2.3	11.4	0.0	3.3	23.2	0.0	2.3
New disturbance (acres)	6.4	0.0	0.0	0.0	0.0	0.0	7.7	0.0	9.7	0.0	0.0	6.4	0.0	2.4	10.2	0.0	3.1	22.6	0.0	2.9
Access Type D - Needs new downline primary access																				
Approximate alignment length (mi)	4.1	11.3	0.0	10.8	10.6	6.1	14.9	14.8	0.0	0.0	1.4	11.7	29.3	12.9	10.4	0.9	0.0	1.0	2.4	0.0
Proposed width of new primary access road (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
New disturbance (acres)	8.0	22.0	0.0	21.0	20.6	11.8	28.8	28.7	0.0	0.0	2.6	22.7	56.8	24.9	20.3	1.7	0.0	2.0	4.6	0.0
Total disturbance to areas disturbed previously (acres)	13.9	0.0	0.0	0.0	0.0	0.0	6.2	0.0	8.6	0.0	0.0	17.0	0.0	2.3	11.4	0.0	3.3	23.2	0.0	2.3
Total new disturbance (acres)	14.4	22.0	7.3	21.0	27.6	12.4	45.8	28.7	14.7	6.1	5.5	29.1	58.4	28.9	31.6	1.8	4.2	24.6	4.6	2.9
New distubance per mile (acres/mile)	1.07	2.00	0.57	2.00	0.93	1.67	1.10	1.98	0.84	0.51	0.62	1.28	1.85	1.15	1.24	1.63	0.57	1.28	2.00	1.25
Total new disturbance within Southline ROW (acres)	9.1	22.0	1.6	21.0	23.1	12.0	32.2	28.7	2.2	1.5	3.6	24.1	57.2	26.5	22.2	1.8	0.9	4.1	4.6	0.3
Total new disturbance outside Southline ROW (acres)	5.2	0.0	5.7	0.0	4.5	0.4	13.5	0.0	12.5	4.6	1.9	4.9	1.2	2.4	9.4	0.0	3.3	20.5	0.0	2.6
Total length of permanent access roads (miles):																				
Existing - No improvement necessary (~parallels ROW	0.0	0.0	13.2	0.0	19.8	1.5	21.2	0.0	8.9	12.3	7.7	0.0	3.3	11.2	5.2	0.2	4.5	0.0	0.0	0.0
Existing - Improvement required (~parallels ROW)	9.6	0.0	0.0	0.0	0.0	0.0	6.4	0.0	8.9	0.0	0.0	11.7	0.0	1.6	10.4	0.0	3.0	19.2	0.0	2.4
New longitudinal roads within Southline ROW	4.1	11.3	0.0	10.8	10.6	6.1	14.9	14.8	0.0	0.0	1.4	11.7	29.3	12.9	10.4	0.9	0.0	1.0	2.4	0.0
New spur roads within Southline ROW	0.8	0.0	1.1	0.0	1.7	0.1	2.4	0.0	1.5	1.1	0.7	0.5	0.3	1.1	1.3	0.0	0.6	1.5	0.0	0.2
New spur roads outside ROW but inside 2 mi. corridor	0.4	0.0	3.9	0.0	3.1	0.3	5.1	0.0	2.6	3.2	1.3	0.0	0.8	0.7	0.4	0.0	0.5	4.5	0.0	0.2

TABLE D-4: ACCESS ROAD CHARACTERIZATION AND DISTURBANCE ESTIMATES – AGENCY ALTERNATIVE SEGMENTS

	Agency 345 kV Alternatives						Agency 230 kV Alternatives																	
Segment Designation	**LD1**	**LD2**	**LD3a**	**LD3b**	**WC1a**	**WC1b**	**MA1**	**TH1opt**	**TH1a**	**TH1b**	**TH1c**	**TH2opt**	**TH2a**	**TH2b**	**TH2c**	**TH3optA**	**TH3optB**	**TH3optC**	**TH3a**	**TH3b**	**BE2a**	**BE2b**	**BE2c**
Approximate Segment Length (mi.)	35.3	9.9	28.6	1.9	14.8	0.4	1.0	0.4	1.4	1.6	0.3	1.0	1.0	0.4	0.5	0.8	0.8	1.6	2.7	4.5	7.4	0.9	17.5
Longitudinal Access Road Length Modifier due to Terrain	1.03	1.02	1.02	1.03	1.02	1.05	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.02	1.03	1.02	1.02	1.04
Land Use																							
Barren	60%	100%	100%	100%																			
Rural/Industrial	40%				100%	100%	100%	100%	50%	90%	100%	50%	100%	100%	80%	100%	50%	50%	80%	80%	100%	100%	100%
Residential									50%	10%		50%			20%		50%	50%	20%	20%			
Primary Access Roads																							
Access Type A - Access from adequate private roads	15%				10%	50%	100%			40%	100%	70%			100%	100%	100%	100%	100%	100%			10%
Access Type B - Parallel to maintained public roads			30%	100%				100%	100%	60%			40%								60%	100%	
Access Type C - Parallel to existing utility roads	45%		60%		10%							30%	60%	100%							40%		50%
Access Type D - Needs new downline primary access	40%	100%	10%		80%	50%																	40%
Access Type A - Access from adequate private roads																							
Approximate alignment length (mi)	5.5	0.0	0.0	0.0	1.5	0.2	1.0	0.0	0.0	0.7	0.3	0.7	0.0	0.0	0.5	0.8	0.8	1.6	2.8	4.6	0.0	0.0	1.8
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Average length of spur roads (ft)	400				400	300	150			400	200	150			300	300	200	300	300	300			500
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
New disturbance (acres)	2.7	0.0	0.0	0.0	0.7	0.1	0.2	0.0	0.0	0.4	0.1	0.2	0.0	0.0	0.2	0.4	0.2	0.7	1.3	2.1	0.0	0.0	1.4
Access Type B - Parallel to maintained public roads																							
Approximate alignment length (mi)	0.0	0.0	8.8	2.0	0.0	0.0	0.0	0.4	1.4	1.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.9	0.0
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Average length of spur roads (ft)			200	200				200	100	200			200								250	250	
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
New disturbance (acres)	0.0	0.0	2.2	0.5	0.0	0.0	0.0	0.1	0.2	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.3	0.0
Access Type C - Parallel to existing utility roads																							
Approximate alignment length (mi)	16.4	0.0	17.5	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	9.1
Average width of existing utility roads (ft)	10		9		9							9	9	9							9		9
Proposed width of upgraded utility roads (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Percent of existing utility roads needing upgrades	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Average number of new spur roads per mile	4.5	4.5	4.5	4.5	4.5	4.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Average length of spur roads (ft)	300		200		200							100	200	200							200		400
Average width of spur roads (ft)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Disturbance to areas disturbed previously (acres)	19.8	0.0	19.1	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	9.9
New disturbance (acres)	18.0	0.0	19.2	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	13.2
Access Type D - Needs new downline primary access																							
Approximate alignment length (mi)	14.5	10.1	2.9	0.0	12.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
Proposed width of new primary access road (ft)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
New disturbance (acres)	28.2	19.6	5.7	0.0	23.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.1
Total disturbance to areas disturbed previously (acres)	19.8	0.0	19.1	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	9.9
Total new disturbance (acres)	48.9	19.6	27.0	0.5	25.8	0.5	0.2	0.1	0.2	0.7	0.1	0.5	0.8	0.5	0.2	0.4	0.2	0.7	1.3	2.1	5.2	0.3	28.7
New distubance per mile (acres/mile)	1.39	1.98	0.94	0.26	1.74	1.21	0.23	0.31	0.15	0.43	0.31	0.47	0.83	1.17	0.46	0.47	0.31	0.46	0.46	0.47	0.70	0.39	1.64
Total new disturbance within Southline ROW (acres)	30.9	19.6	8.9	0.2	23.8	0.4	0.1	0.0	0.2	0.2	0.0	0.1	0.1	0.0	0.1	0.1	0.1	0.2	0.3	0.5	0.9	0.1	15.4
Total new disturbance outside Southline ROW (acres)	18.0	0.0	18.1	0.2	2.0	0.1	0.1	0.1	0.1	0.5	0.1	0.4	0.7	0.4	0.2	0.3	0.2	0.6	0.9	1.6	4.3	0.2	13.4
Total length of permanent access roads (miles):																							
Existing - No improvement necessary (~parallels ROW	5.5	0.0	8.8	2.0	1.5	0.2	1.0	0.4	1.4	1.6	0.3	0.7	0.4	0.0	0.5	0.8	0.8	1.6	2.8	4.6	4.5	0.9	1.8
Existing - Improvement required (~parallels ROW)	16.4	0.0	17.5	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	9.1
New longitudinal roads within Southline ROW	14.5	10.1	2.9	0.0	12.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3
New spur roads within Southline ROW	1.9	0.0	2.2	0.2	0.3	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.4	0.6	0.1	0.9
New spur roads outside ROW but inside 2 mi. corridor	4.2	0.0	2.2	0.2	0.5	0.0	0.1	0.1	0.0	0.3	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.4	0.6	1.1	1.2	0.2	3.9

Appendix E
Traffic Count Estimates

This appendix describes the level of construction and operations vehicular traffic anticipated for the proposed project.

Substation Construction

The level of construction traffic impacts would be heavily dependent on the size of the substation additions and the phase of construction. There would be up to 15 substations included in this proposed project and work would occur simultaneously at multiple substations at the same time.

Typically the laborers would use their personal vehicles to travel from their place of lodging to the substation site. Many would car-pool and most will not leave the site until the end of the day. Round trip personal vehicle usage is expected to vary from 4 to 40 per day, per active substation site. The non-local workers would typically rent housing or trailer hook-ups in the local towns and would periodically relocate as construction progresses down-line. The local workers would come from nearby towns but may have increasingly greater travel distances until the construction gets too far from home to make it worth the commute. It is expected that the average commute would be about 20 miles for non-locals and about 30 miles for locals. Counties with adequate amounts of housing near each substation would see a higher percentage of in-county commuting. The percentage of workers that would be commuting from the same county they are working in is estimated as follows:

- 60% in Dona Ana County, NM
- 80% in Luna County, NM
- 80% in Hidalgo County, NM
- 80%in Cochise County, AZ
- 90% in Pima County, AZ
- 10% in Pinal County, AZ

Construction management and inspection personnel may come and go in pick-up trucks throughout the day (anticipated at 3 to 15 times per day per active substation site).

Once delivered, construction equipment would typically remain onsite for the duration of its need there. Equipment deliveries from 3 to 15 per month per active substation site are common.

There would be ongoing deliveries of material, mostly via flatbed trucks or trucks with trailers. Material deliveries usually come in bunches over a few days and there would be many days when there would be no material deliveries. Material deliveries from 10 to 50 per month per active substation site are common.

Concrete delivery trucks would make deliveries to the site throughout the foundation construction phase. It is anticipated that towns with ready-mix concrete enterprises would provide concrete for nearby substations, and that concrete batch plants would serve remote substations. It is expected that the concrete batch plants would operate out of the transmission line staging areas. Round trip concrete truck usage is expected to vary from 2 to 20 per day per active substation site during the foundation construction phase.

The substations would not be manned during operation. Personnel providing periodic maintenance would usually arrive by pick-up truck, flatbed truck, and/or bucket truck. From 2 to 10 truck visits per year per active substation site is common.

Transmission Line Construction

The level of construction traffic impacts would be dependent on the phase of construction. Construction would occur in a serial fashion with access crews, foundation crews, structure assembly/erection crews, stringing crews, and cleanup crews following each other. It is anticipated that 15 to 25 construction staging areas would be utilized on the proposed project depending upon final routing and contractor preferences. Each staging area would be active for several months and multiple staging areas would be active at the same time. Most staging areas would be located near the right-of-way along state or county roads or would be located adjacent to interstate highway exits that provide reasonable access to the right-of-way.

Typically the laborers would use their personal vehicles to travel from their place of lodging to the construction staging area nearest to the section of line they would be working on. Many would car-pool. Round trip personal vehicle usage is expected to vary from 4 to 40 per day per active staging area. The non-local workers would typically rent housing or trailer hook-ups in the local towns and would periodically relocate as construction progresses down-line. The local workers would come from nearby towns but may have increasingly greater travel distances until the construction gets too far from home to make it worth the commute. It is expected that the average commute would be about 20 miles for non-locals and about 30 miles for locals. Counties with long transmission segments and adequate amounts of housing near the transmission line route would see a higher percentage of in-county commuting. The percentage of workers that would be commuting from the same county they are working in is estimated as follows:

- 60% in Dona Ana County, NM
- 80% in Luna County, NM
- 20% in Grant County, NM
- 80% in Hidalgo County, NM
- 80%in Cochise County, AZ
- 90% in Pima County, AZ
- 10% in Pinal County, AZ

Crews are typically transported from the staging area to the work site via company trucks or vans. Crews may stay at one structure site all day or may work across a section of structure sites up to 2 miles long. In areas where the primary access to the right-of-way is from a parallel public road, the crews would need to utilize the public road long enough to get to the spur road for the next structure. Otherwise, the crews would typically be on the right-of-way (or on parallel utility access roads) all day. Round trip company vehicle usage for the purpose of transporting crews is expected to vary from 3 to 30 per day per active staging area.

Construction management and inspection personnel may come and go to the staging area via public roads in pick-up trucks throughout the day (anticipated at 3 to 15 times per day per active staging area).

Construction management and inspection personnel may travel between the staging area and the structure sites in pick-up trucks throughout the day (anticipated at 5 to 20 times per day per active staging area).

Heavy construction equipment would typically move from one structure site to the next and remain overnight on the right-of-way.

There would be ongoing deliveries of material to the staging areas, mostly via large trucks. Material deliveries from 10 to 50 per month per active staging area are common.

As the material is needed by the crews it would be transported to the structure sites via flatbed trucks or trucks with trailers. Material deliveries from 40 to 100 per month per active staging area are common. Trucks transporting raw material to each concrete batch plants would be assumed to have an average weight of 20 tons and travel 100 miles round trip.

Concrete delivery trucks would make deliveries to the site throughout the foundation construction phase. It is anticipated that towns with ready-mix concrete enterprises would provide concrete for nearby structure sites, and that concrete batch plants would serve remote structure sites. It is expected that the concrete batch plants would operate out of the staging areas. Round trip concrete truck usage is expected to vary from 4 to 30 per day per active staging area during the foundation construction phase. It is anticipated that each one would service locations at distances up to 15 miles, with a typical delivery distance of approximately 7 miles.

Following construction, personnel providing periodic inspection and maintenance would usually arrive by pick-up truck and/or bucket truck. Each structure site is typically visited 1 to 2 times per year.

Appendix F
Water Usage Estimates

Water would be obtained from existing sources along the right-of-way. Primarily, water use would be for dust control. Water would be trucked in from a variety of existing sources and no wells would be drilled. No new water sources would be developed for this proposed project.

The amount of water needed for dust suppression would vary by the type of access, the geotechnical properties of the soils, the weather, the level of construction activity, and proximity to the public. At this time, it is anticipated that between 40,000 and 100,000 gallons of water per mile of transmission line would be used for dust suppression, which equates to 45 to 110 acre-feet for the proposed project.

Water would also be required for concrete foundations. Table F-1 provides estimates of transmission line foundation quantities, sizes, concrete volumes, and water usage required for those foundations. Table F-2 provides estimates of substation foundation quantities, concrete volumes, and water usage required for those foundations. Data in these tables indicate that an additional 3.1 million gallons of water would be required for foundation construction, which equates to about 10 acre-feet.

TABLE F-1: FOUNDATION SIZES AND WATER REQUIREMENTS – TRANSMISSION LINES

345 kV DOUBLE CIRCUIT LATTICE TOWERS

Total Miles	240
Structures Per Mile	4.5
Total Number of Structures	1080
Gallons of Water per Cubic Yard	35

	Pier Length (ft)	Pier Diameter (ft)	Concrete Per Pier (CY)	No. of Piers Per Struct	Concrete Per Struct. (CY)	Water Per Struct. (Gallons)	Structure Usage (%)	No. of Structures	Total Concrete (CY)	Total Water (Gallons)
Tangent	30	3	7.9	4	31.4	1100	90%	972	30,548	1,069,181
Running Angle	35	4	16.3	4	65.2	2281	5%	54	3,520	123,198
Deadend	50	6	52.4	4	209.5	7333	5%	54	11,314	395,993
Total								1080	45,382	1,588,371
Total per Mile									189	6,618

230 kV DOUBLE CIRCUIT TUBULAR STEEL (Note: It is possible the tangents will be direct-embedded which would greatly reduce the concrete volumn shown)

Total Miles	120
Structures Per Mile	5.5
Total Number of Structures	660
Gallons of Water per Cubic Yard	35

	Pier Length (ft)	Pier Diameter (ft)	Concrete Per Pier (CY)	No. of Piers Per Struct	Concrete Per Struct. (CY)	Water Per Struct. (Gallons)	Structure Usage (%)	No. of Structures	Total Concrete (CY)	Total Water (Gallons)
Tangent	25	7	35.6	1	35.6	1248	85%	561	19,998	699,939
Running Angle	30	8	55.9	1	55.9	1956	7%	46.2	2,581	90,345
Deadend (2-Pole)	30	9	70.7	2	141.4	4950	8%	52.8	7,467	261,355
Total								660	30,047	1,051,639
Total per Mile									250	8,764

TABLE F-2: FOUNDATION SIZES AND WATER REQUIREMENTS – SUBSTATIONS

		Concrete Volume (CY)	345 kV New Build Qty	230 kV Upgrade Qty
Equipment	**500kV Circuit Breaker**	18	0	2
	345kV Circuit Breaker	15	36	3
	230kV Circuit Breaker	12	9	43
	115kV Circuit Breaker	10	0	3
	500kV Disconnect Switch	24	0	4
	345kV Disconnect Switch	16	122	6
	230kV Disconnect Switch	14	18	108
	115kV Disconnect Switch	6	0	6
	345kV Metering Unit	4	66	0
	230kV Metering Unit	3.5	12	66
	345kV Arrester	4	42	0
	230kV Arrester	3.5	6	66
	345kV Phase Shifter Transformer	40	2	0
	500/230kV 598 MVA Transformer	20	0	1
	345/230kV 650 MVA Transformer	20	2	0
	230/115kV 300 MVA Transformer	15	0	4
	345/230kV 720 MVA Transformer	20	0	2
	230/115kV 615 MVA Transformer	20	0	3
	230/115kV 462 MVA Transformer	15	0	2
	345kV Shunt Capacitor (50 MVAR)	15	2	2
	345kV Shunt Capacitor (100 MVAR)	20	1	0
	345kV Shunt Capacitor (25 MVAR)	10	2	0
	345kV Series Cap Bank (123 MVAR)	20	4	0
	345kV Series Cap Bank (147 MVAR)	20	4	0
	345kV Series Cap Bank (159 MVAR)	20	4	0
	345kV Line Reactor (111 MVAR)	20	4	0
	345kV Line Reactor (134 MVAR)	20	4	0
	345kV Line Reactor (144 MVAR)	20	4	0
	345kV Shunt Reactor (50 MVAR)	15	2	0
	345kV SVC (-50/+250 MVAR)	200	1	0
	500kV Bus Supports	4.5	0	3
	345kV Bus Supports	4	519	18
	230kV Bus Supports	3.5	42	357
	115kV Bus Supports	3	0	39
	500kV Deadend	25	0	1
	345kV Deadend	20	56	5
	230kV Deadend	15	6	32
	230kV Deadend	10	0	1
	Control Building	20	4	10

345 kV New Build Total Concrete (cy)	7760		
230 kV Rebuild Total Concrete (cy)		5336	
345 kV New Build Water @ 35 gal/cy (gal)	271,600		
230 kV Rebuild Water @ 35 gal/cy (gal)		186,760	

13,096 Total CY for Substation Work

458,360 Total gallons for Substation Work

Appendix G
Substation Disturbance Estimates

Table G-1 provides disturbance estimates for each substation.

TABLE G-1: ESTIMATED SUBSTATION DISTURBANCE

Substation	Total Study Area	Study Area for Existing Station Disturbance Area	Study Area for Additional Permanent Disturbance	Study Area for Additional Temporary Disturbance	Additional Access Road Requirements
Adams Tap	4.9 acres	0.3 acres	4 acres	None	0.2 acre
Afton	19 acres	2.8 acres	10 acres	10 acres	Less than 0.1 acre
Apache	69.5 acres	0.1 acres	28 acres	10 acres	Less than 0.1 acre
Del Bac	13.6 acres	0.8 acres	5 acres	5 acres	Up to 0.5 acre
DeMoss Petrie	4.2 acres	4.2 acres	None	None	None
Hidalgo	39.7 acres	4.5 acres	25 acres	10 acres	Less than 0.1 acre
Marana	14.1 acres	1.6 acres	5 acres	5 acres	Less than 0.1 acre
Nogales	10.3 acres	0.9 acres	5 acres	4 acres	0.1 acre
Pantano	25.8 acres	1 acres	5 acres	5 acres	0.5 acre
Rattlesnake	17 acres	0.2 acres	5 acres	5 acres	0.4 acre
Saguaro	29.2 acres	0.1 acres	7 acres	5 acres	Up to 9 acres, not included in Polygon
Tortolita	15.9 acres	14.7 acres	1.4 acres	None	None
Tucson	11.7 acres	7 acres	3.7 acres	None	None
Vail	29 acres	3 acres	5 acres	5 acres	Less than 0.1 Acre
Midpoint	Varies	None	25 acres	10 acres	Varies

Appendix H
Substation Equipment Breakdown

Table H-1 provides major equipment quantity and type estimates for each substation.

TABLE H-1: SUBSTATION EQUIPMENT BREAKDOWN

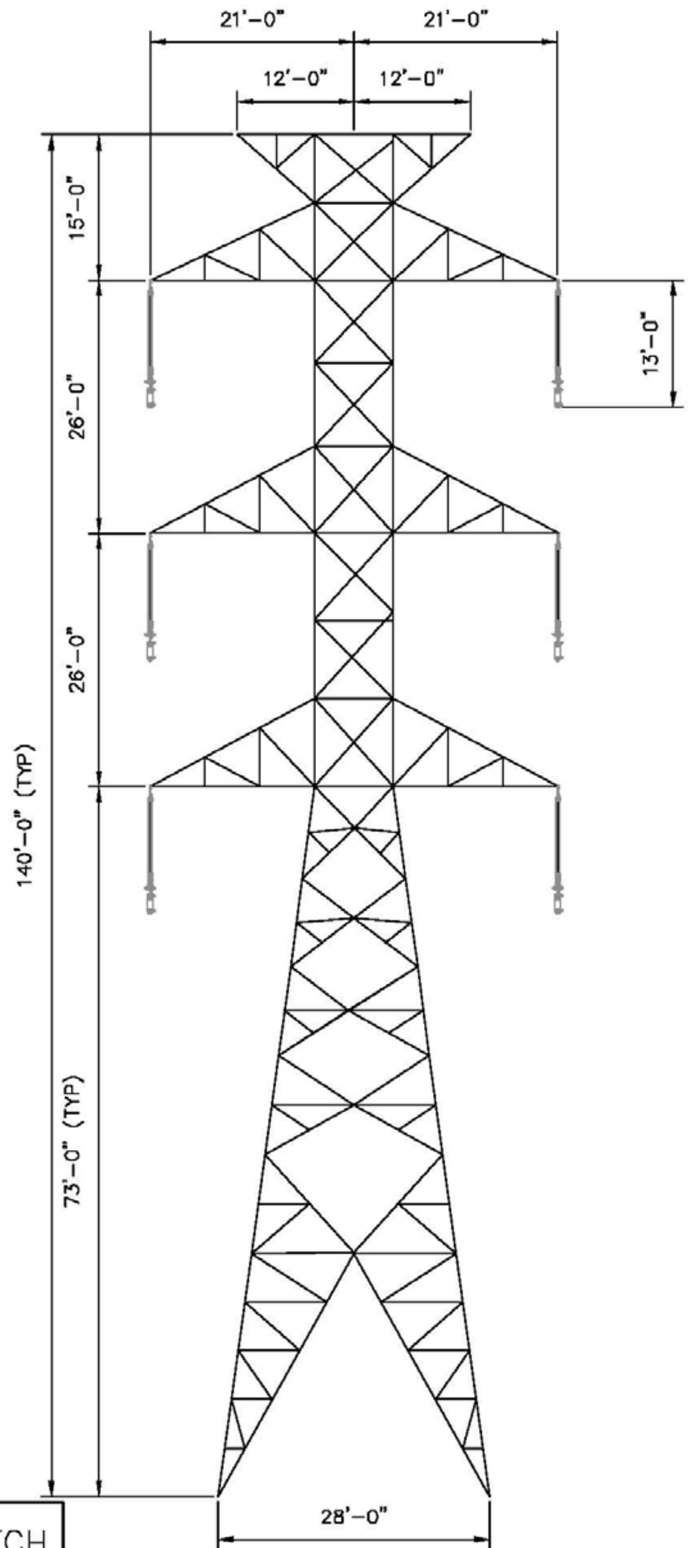
	Substation Quantities															
Equipment	Total	Afton	Midpoint	Hidalgo	Apache	Adams Tap	Pantano	Vail	Nogales	Del Bac	De Moss Petrie	Tucson	Rattlesnake	Marana	Saguaro	Tortolita
500kV Circuit Breaker	2															2
345kV Circuit Breaker	42	10	8	10	11			3								
230kV Circuit Breaker	44				9	3	4	4	2	2		11	3	3	3	
138kV Circuit Breaker	3										3					
115kV Circuit Breaker	7											2			5	
500kV Disconnect Switch	4															4
345kV Disconnect Switch	84	20	16	20	22			6								
230kV Disconnect Switch	88				18	6	8	8	4	4		22	6	6	6	
138kV Disconnect Switch	6										6					
115kV Disconnect Switch	14											4			10	
500kV CCVT	1															1
345kV CCVT	65	18	12	19	14			2								
230kV CCVT	101				20	6	12	8	6	6		21	7	7	5	3
138kV CCVT	12										6	6				
115kV CCVT	12														12	
345kV Arrester	42	12	12	12	6											
230kV Arrester	78				12	6	12	6	6	6		12	6	6	3	3
138kV Arrester	12										6	6				
115kV Arrester	12														12	
345kV Phase Shifter Transformer	2	2														
500/230kV 598 MVA Transformer	1															1
345/230kV 650 MVA Transformer	2				2											
230/115kV 287 MVA Transformer	4					1						1	1	1		
345/230kV 600 MVA Transformer	2							2								
230/138kV 615 MVA Transformer	2											2				
230/115kV 410 MVA Transformer	2														2	
345kV Series Cap Bank (42 MVAR)	4	2	2													
345kV Series Cap Bank (123 MVAR)	4			2	2											
345kV Series Cap Bank (93 MVAR)	4		2	2												
345kV Line Reactor (13 MVAR)	4	2	2													
345kV Line Reactor (39 MVAR)	4			2	2											
345kV Line Reactor (29 MVAR)	4		2	2												
345kV Shunt Reactor (50 MVAR)	2				2											
345kV SVC (-50/+250 MVAR)	1				1											
500kV Bus Supports	24															24
345kV Bus Supports	527	87	138	168	102			32								
230kV Bus Supports	450				42	42	36	36	54	54		60	42	42	42	
138kV Bus Supports	12										6	6				
115kV Bus Supports	57												9	9	39	
500kV Deadend	3															3
345kV Deadend	62	12	16	18	12			4								
230kV Deadend	34				6	3	4	4	2	2		7	2	3	1	
138kV Deadend	4										2	2				
115kV Deadend	3														3	
New Control Building	9		1	1	1	1	1	1				1		1	1	
Utilize Existing Control Building	10	1		1	1			1	1	1	1		1		1	1
Control and Protection Relay Panels	230	22	28	32	48	5	12	14	4	4	4	23	5	9	15	5

Appendix I
Typical Transmission Structure Diagrams

This appendix contains concept diagrams of typical transmission structures that could be used on the Project. Tangent structures are used at 80 to 90 percent of the structure sites on a typical transmission line. Suspension angle structures would be used for line angles between ~1° and ~25°. Deadend structures would be used for line angles between ~25° and ~90°, and in special situations (e.g. critical line crossing). Structure requirements will be finalized after final routing is known.

It is anticipated that transpositions would be required on line segments with over 50 miles between substations. It is anticipated that two sets of transpositions would be located in the Midpoint-Hidalgo line segment and two sets in the Hidalgo-Apache 345 kV line segment. Transpositions would be located at approximately one-third points along these line segments. Each set of transpositions would consist of two pairs of single circuit poles.

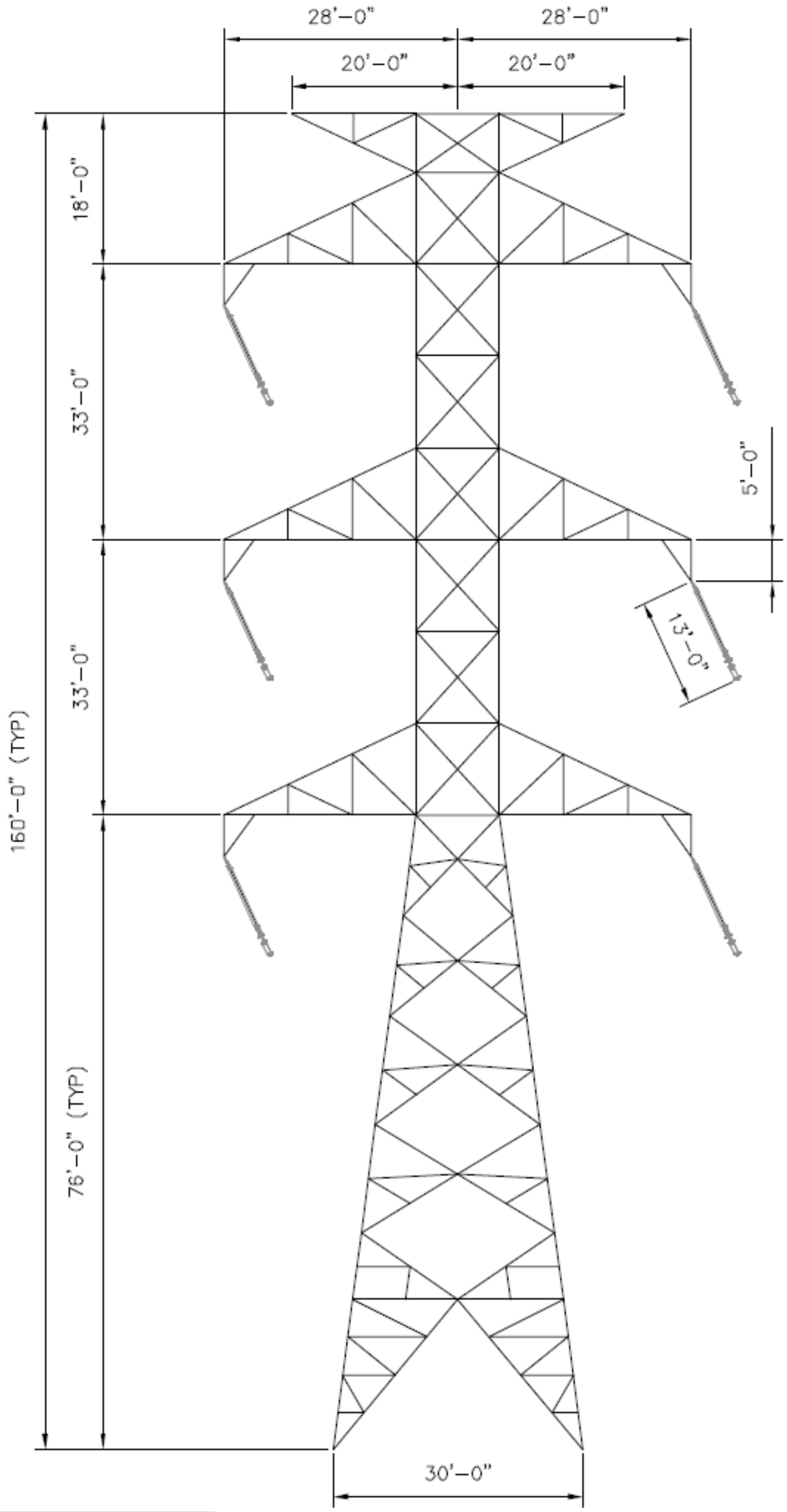
FIGURE 4-5A: TYPICAL 345-KV TANGENT LATTICE STRUCTURE



BLACK & VEATCH

DRAWN	DATE	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER	REV
JEF	6–7–13		Figure 4–5A	B
ENGINEER	DATE	AFTON – APACHE 345KV TRANSMISSION LINE	TYPICAL 345KV TANGENT LATTICE STRUCTURE	
AGR	6–7–13			

FIGURE 4-5B: TYPICAL 345-KV SUSPENSION ANGLE LATTICE STRUCTURE



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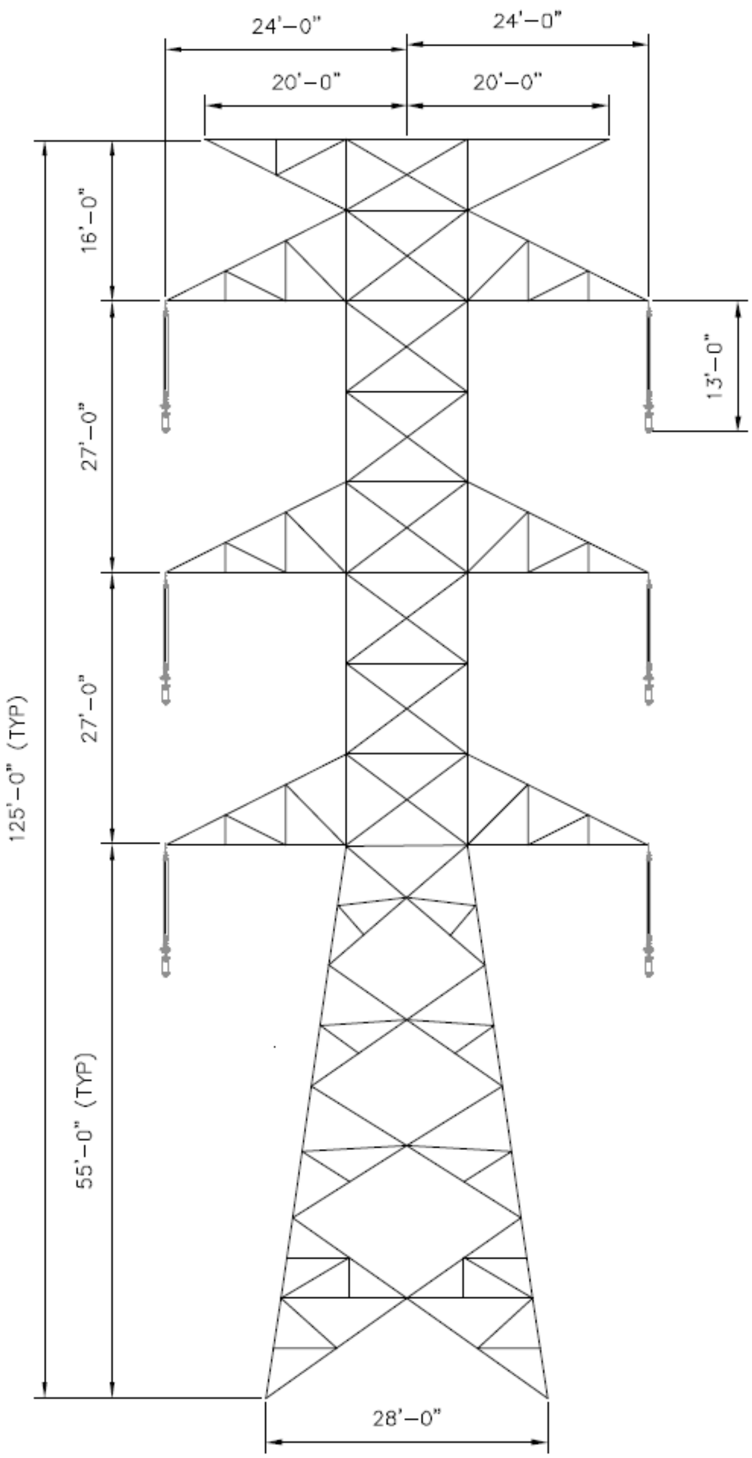
DRAWN	DATE	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER	REV
JEF	6–7–13		Figure 4–5B	A
ENGINEER	DATE	AFTON – APACHE	TYPICAL 345KV	
AGR	6–7–13	345KV TRANSMISSION LINE	SUSPENSION ANGLE LATTICE STRUCTURE	

FIGURE 4-5C: TYPICAL 345-KV DEADEND LATTICE STRUCTURE



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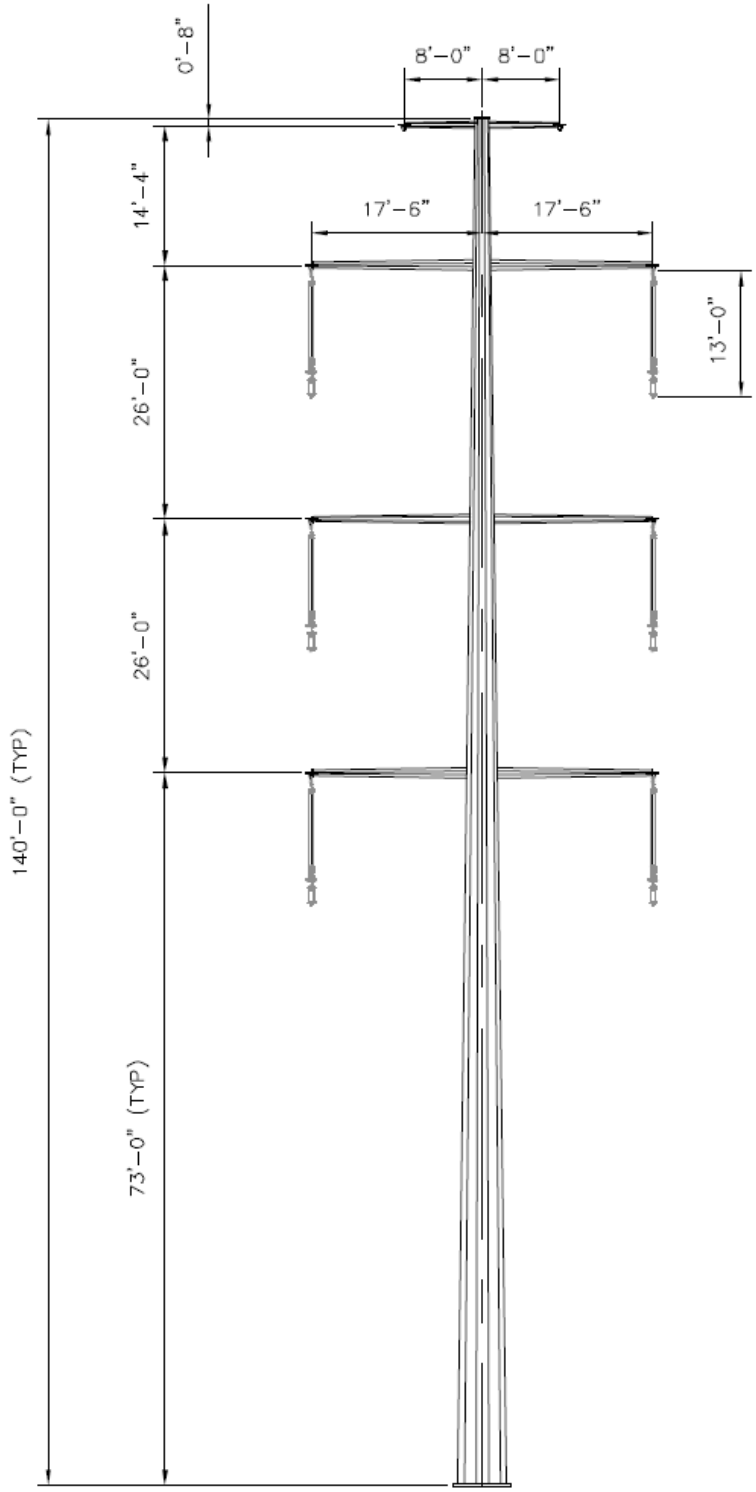
DRAWN JEF	DATE 6–7–13	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER Figure 4–5C	REV A
ENGINEER AGR	DATE 6–7–13	AFTON – APACHE 345KV TRANSMISSION LINE	TYPICAL 345KV DEADEND LATTICE STRUCTURE	

FIGURE 4-6: TYPICAL 345-KV TANGENT TUBULAR STEEL STRUCTURE



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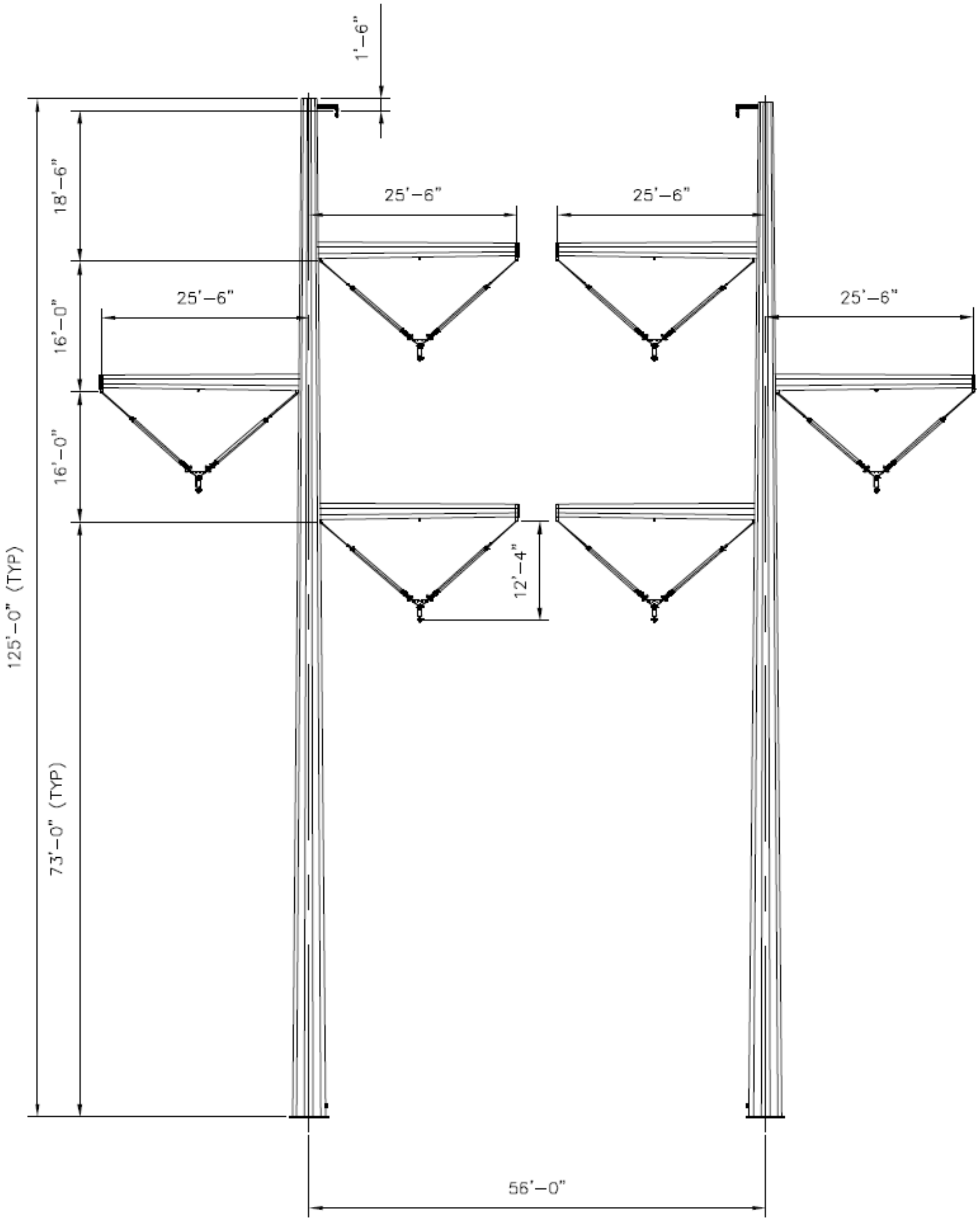
DRAWN JEF	DATE 6–7–13	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER Figure 4–6	REV B
ENGINEER AGR	DATE 6–7–13	AFTON – APACHE 345KV TRANSMISSION LINE	TYPICAL 345KV TANGENT TUBULAR STEEL STRUCTURE	

FIGURE 4-6B: TYPICAL 345-KV TRANSPOSITION TUBULAR STEEL STRUCTURE



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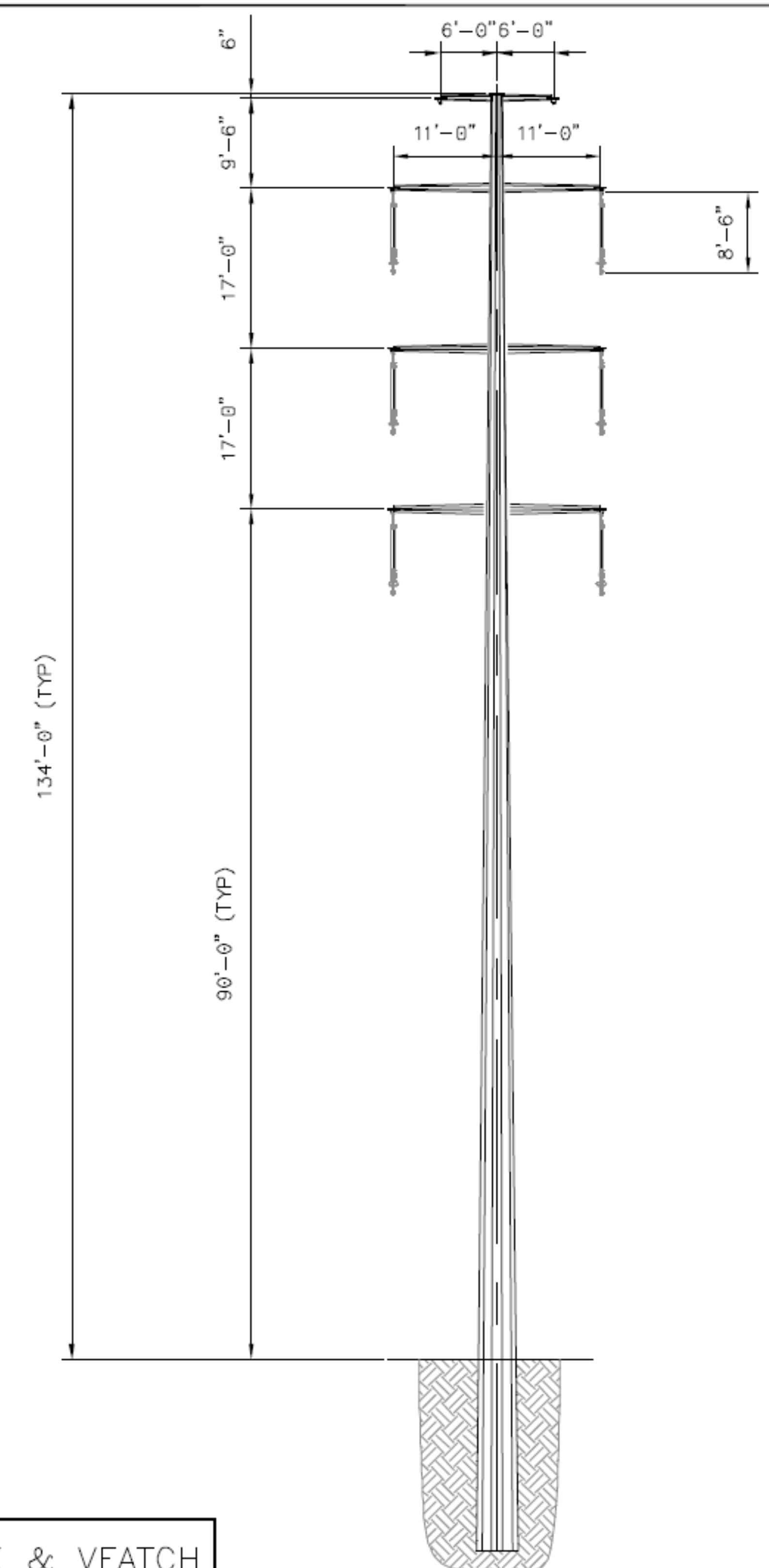
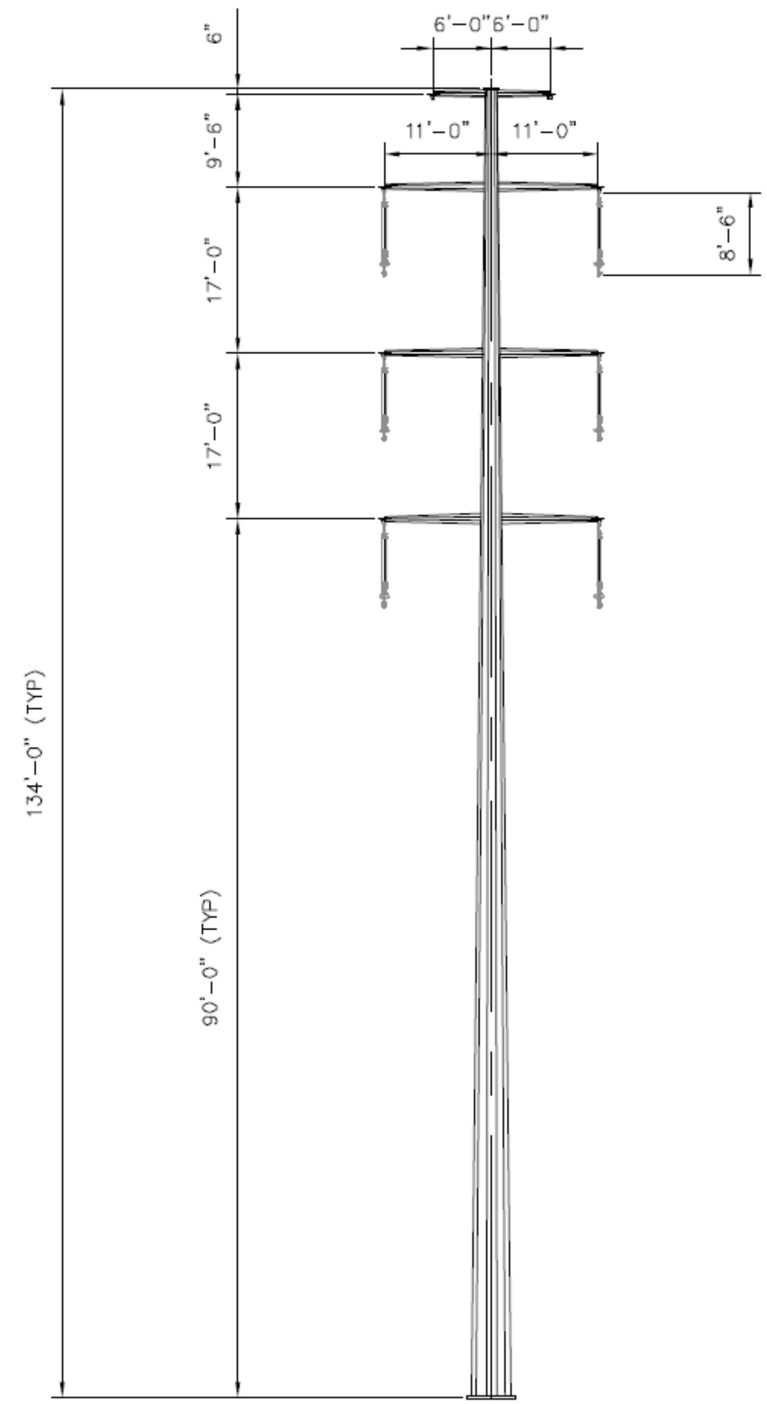
DRAWN JEF	DATE 6–7–13	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER Figure 4–6B	REV A
ENGINEER AGR	DATE 6–7–13	AFTON – APACHE 345KV TRANSMISSION LINE	TYPICAL 345KV TRANSPOSITION TUBULAR STEEL STRUCTURE	

FIGURE 4-7: TYPICAL 230-KV DIRECT EMBEDDED TANGENT TUBULAR STEEL STRUCTURE



BLACK & VEATCH				
DRAWN JEF	DATE 6–7–13	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER Figure 4–7	REV B
ENGINEER AGR	DATE 6–7–13	APACHE – SAGUARO 230KV TRANSMISSION LINE	TYPICAL 230KV DIRECT EMBEDED TANGENT TUBULAR STEEL STRUCTURE	

FIGURE 4-8A: TYPICAL 230-KV TANGENT TUBULAR STEEL STRUCTURE (FOUNDATION TYPE)



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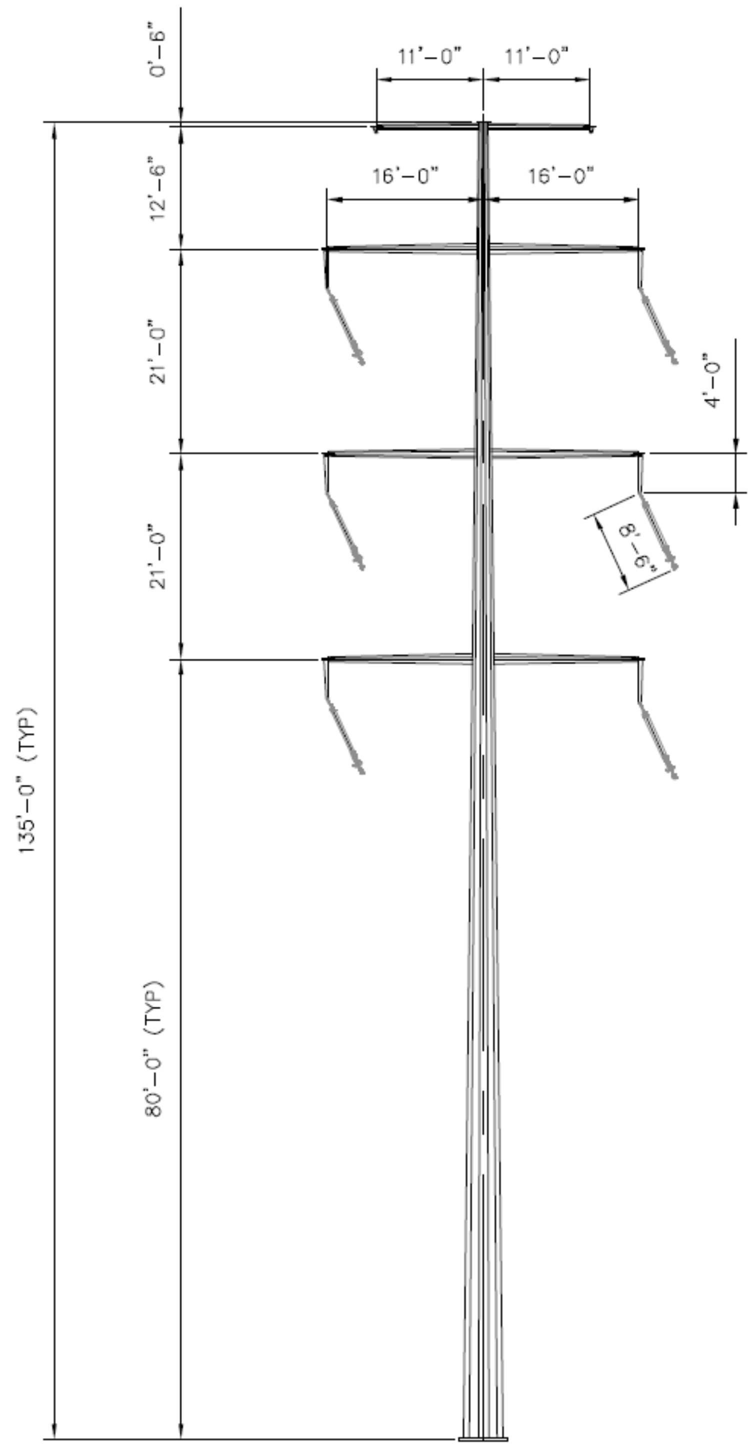
DRAWN	DATE		DRAWING NUMBER	REV
JEF	6–7–13	SOUTHLINE TRANSMISSION PROJECT	Figure 4–8A	B
ENGINEER	DATE			
AGR	6–7–13	APACHE – SAGUARO 230KV TRANSMISSION LINE	TYPICAL 230KV TANGENT TUBULAR STEEL STRUCTURE	

FIGURE 4-8B: TYPICAL 230-KV SUSPENSION ANGLE TUBULAR STEEL STRUCTURE



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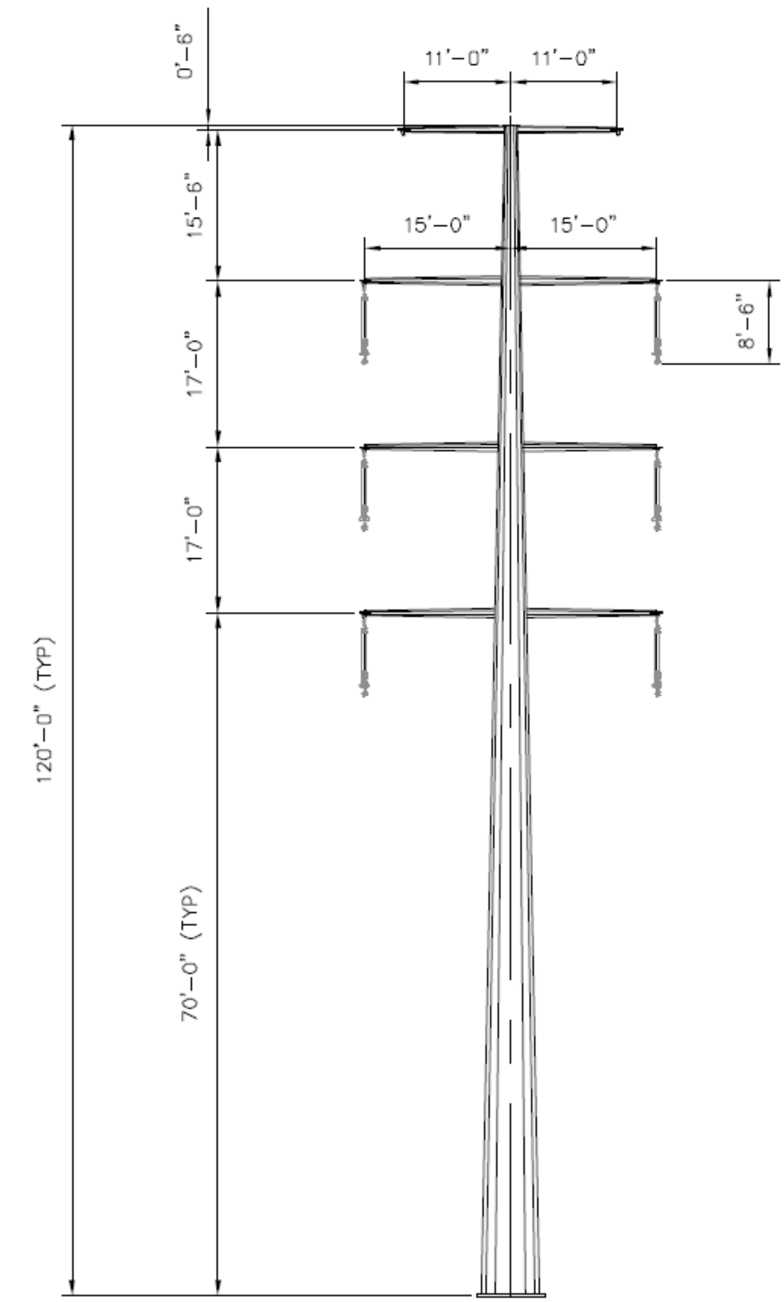
DRAWN JEF	DATE 6-7-13	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER Figure 4-8B	REV A
ENGINEER AGR	DATE 6-7-13	APACHE - SAGUARO 230KV TRANSMISSION LINE	TYPICAL 230KV SUSPENSION ANGLE TUBULAR STEEL STRUCTURE	

FIGURE 4-8C: TYPICAL 230-KV DEADEND TUBULAR STEEL STRUCTURE



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DRAWN JEF	DATE 6–7–13	SOUTHLINE TRANSMISSION PROJECT	DRAWING NUMBER Figure 4–8C	REV A
ENGINEER AGR	DATE 6–7–13	APACHE – SAGUARO 230KV TRANSMISSION LINE	TYPICAL 230KV DEADEND TUBULAR STEEL STRUCTURE	