3.5.9.2 Construction Workforce

The proposed TWE Project will be constructed by contract personnel, with the Applicant responsible for project management, project administration and inspection. The construction workforce will consist of laborers, craftsmen, supervisory personnel, support personnel, and construction management personnel who will perform the construction tasks. Estimated construction workforce requirements by major activity are summarized in Tables 6 and 7.

Table 6 identifies the estimated personnel and equipment that is required for each of the three transmission line spreads. The total estimated number of construction personnel for construction of the entire transmission line is 630 people. Table 7 identifies the estimated personnel and equipment that is required for each of the two terminals and each of the two ground electrodes. The total estimated number of construction personnel for construction of both terminals and both ground electrodes is 360 people. The total estimated workforce for the complete proposed Project is approximately 1,000 people.

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

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

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

The TWE Project does not appear to have areas that are more than 50 miles (on paved roads) from the ROW to existing communities or towns. The average travel distance for the Project is approximately 15 miles. The populations of these towns indicate their capability to handle the housing and/or accommodation demands of the construction workers. It should be noted during typical transmission line construction, the entire work force and support personnel generally do not all work in one area at any given time. Generally one or more activities are completed and the associated crews move to a new location prior to all the other activities becoming fully operational in that area. Section 3.5 describes the construction process, including construction workforce levels and numbers of workers by activities.

3.5.9.3 Construction Equipment

Equipment required for construction of the TWE Project transmission lines, terminals and ground electrode systems will include, but is not limited to, that listed in Tables 6 and 7.

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

TABLE 6 ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		4	Carry alls
		1	Truck, flatbed (2-ton)
		2	Trucks, flatbed, w/boom (5-ton)
		1	Dump truck
		1	Water truck
		2	Concrete trucks
		1	Mechanics truck
		2	Diesel tractors, w/lowboy
		2	Dozers
		1	Loader, front end
		3	Backhoes, w/bucket
		3	Wagon drills
		3	Cranes, all terrain (35-ton)
Structure Steel Haul Crew	8	1	Equipment-tool trailer
		2	Diesel tractors (steel hauling)
		1	Pickup truck
		1	Truck, flatbed (2-ton)
		1	Carry all
		5	Cranes, all terrain (35-ton)
		3	Fork lifts
Structure Assembly Crews 8-9 Crews	72	2	Pickup trucks
		10	Carry alls
		5	Cranes, all terrain (35-ton)
		1	Water truck
		5	Air compressors
		2	Trucks (2-ton)
		1	Mechanics truck
		2	Tool-equipment trailers
Structure Erection Crews 1-2 Crews	20	2	Cranes (120 – 300-ton)
		2	Trucks (2-ton)

TABLE 6 ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		2	Pickup trucks
		5	Carry alls
		1	Mechanics truck
		2	Air compressors
		1	Tool-equipment trailer
Wire Installation Crew	36	6	Wire reel trailers
		4	Haul trailers
		4	Diesel tractors
		4	Cranes (2) 20-ton, (2) 30-ton
		5	Trucks, flatbed, w/bucket (5 -ton)
		4	Pickup trucks
		2	Splicing trucks
		2	3-drum pullers (one medium, one heavy)
		2	Single drum pullers (large)
		1	Backhoe, w/bucket
		1	Water truck
		2	Trucks, flatbed (2-ton)
		4	Double bull-wheel tensioner (two light and two heavy)
		2	Sagging equipment (D-8 Cat)
		6	Carry alls
		2	Static wire reel trailers
		3	Tool-equipment trailers
		2	Mechanics trucks
Clean-up Crew	4	1	Truck, flatbed, w/bucket (5-ton)
		1	Pickup truck
		1	Carry all
Road Rehabilitation Crew (ROW Restoration)	6	1	Dozer (D-8 Cat or equivalent)
		1	Front end loader w/bucket
		1	Backhoe, w/bucket
		1	Diesel tractor, w/lowboy

TABLE 6	ESTIMATED PERSONNEL AND EQUIPMENT FOR TRANSMISSION LINE CONSTRUCTION FOR EACH SPREAD	
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT
	1	Seeding/harrowing equipment, w/tractor
	1	Motor grader
	1	Pickup truck
	1	Dump truck
	1	Carry all
Estimated maximum personnel required for all transmission line tasks including maintenance, management, and quality control personnel = 210 for each of the three spreads.		

TABLE 7	ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM	
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT
Survey Crew	4	2 Pickup trucks
Site Management Crew	10-12	4 Office trailers
		4 Pickups
		4 Generators
Site Development – Civil Work Crew	30-35	4 Scrapers
		2 Dozers (ripper)
		2 Motor graders
		2 Roller compactors
		2 Excavators
		4 Dump trucks
		3 Water trucks
		1 Mechanics truck
		1 Fuel truck
		2 Pickup trucks
		6 Carry alls
Fence Installation Crew	10-20	1 Pickup truck
		1 Boom truck
		2 Carry alls
		1 Backhoe
		1 Concrete truck
		1 Reel stand truck

TABLE 7 ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		2	Bobcats
Equipment Footings Installation Crew	24-30	2	Hole diggers
		2	Boom trucks
		1	Excavator
		3	Concrete trucks
		1	Dump truck
		1	Roller compactor
		2	Plate compactors
		1	Backhoe
		2	Bobcats
		1	Mechanics truck
		1	Fuel truck
		1	Water truck
		2	Pickup trucks
		4	Carry alls
Cable Trench, Conduits, and Station Grounding Crew	12-16	2	Trenchers
		2	Dozers (ripper)
		2	Roller compactors
		2	Plate compactors
		2	Excavators
		1	Boom truck
		3	Pickup trucks
		2	Flatbed trucks
		4	Carry alls
		1	Air compressor
		1	Backhoe
		1	Mechanics truck
		1	Fuel truck
		1	Dump truck
		1	Reel stand truck

TABLE 7 ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Steel Structure and Bus Installation Crew, Converter Valve Hall, Ancillary Buildings Construction Crew, Equipment Assembly and Erection Crew	16-24	2	Cranes, RT
		2	High capacity cranes
		4	Boom trucks
		6	Manlifts
		4	Welder trucks
		2	Carry alls
		3	Pickup trucks
		2	Flatbed trucks
		1	Mechanics truck
		4	Vans
		2	Flatbed trucks
Control Building and Wiring Crew	20-24	2	Boom trucks
		4	Manlifts
		3	Wire pullers-small
		2	Reel stand trucks/trailers
		4	Vans
		4	Pickup trucks
		2	Carry alls
		1	Splicing van
		2	Concrete trucks
		1	Bobcat
		1	Trencher
		2	Plate compactors
Ground Electrode Construction Crew	12-18	2	Pickup trucks
		1	Fuel truck
		1	Water truck
		2	Trenchers
		2	Drill rigs
		1	Boom truck
		2	Flatbed trucks

TABLE 7	ESTIMATED PERSONNEL AND EQUIPMENT FOR EACH TERMINAL AND GROUND ELECTRODE SYSTEM		
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
		1	Bobcat
		1	Backhoe
		1	Mechanics truck
		1	Concrete trucks
		1	Air compressor

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

3.6 Proposed TWE Project Operation and Maintenance Practices

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

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

3.6.1 Transmission Lines

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

Routine maintenance activities are ordinary maintenance tasks that have historically been performed and are regularly carried out on a routine basis. The work performed is typically repair or replacement of individual components (no new ground disturbance), performed by relatively small crews using a minimum of equipment, and usually is conducted within a period from a few hours up

to a few days. Work requires access to the damaged portion of the line to allow for a safe and efficient repair of the facility. Equipment required for this work may include four-wheel-drive trucks, material (flatbed) trucks, bucket trucks (low reach), boom trucks (high reach), or man lifts. This work is scheduled and is typically required due to issues found during inspections. Typical items that may require periodic replacement on structures include insulators, hardware, or structural members. It is expected that these replacements would be required infrequently.

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

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

3.6.2 Transmission Line ROW

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

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

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

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

3.6.2.1 Vegetation Management Program

A Vegetation Management Program will be developed and implemented for the TWE Project. The Program will be designed to meet NERC reliability requirements in a cost-effective manner, and provide measures for minimizing potential conflicts with critical environmental resources or management issues. The vegetation management program for the TWE Project transmission line ROWs will be based on meeting reliability requirements of NERC through integrative vegetation management (IVM) practices (NERC 2009, ANSI 2006). The TWE Project program will comply with NERC reliability standards.

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

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

3.6.2.2 TWE Project Vegetation Management Plan Framework

The Applicant will develop the Vegetation Management Plan for the Agency Preferred Alternative. The Plan would be developed during Project engineering and design, and would be part of the COM Plan. For purposes of the DEIS analysis, the following provides a framework summary of the draft program, including desired conditions and implementation strategies.

The TWE Project Vegetation Management Program will establish and maintain several levels or types of desired conditions within the TWE Project transmission line ROWs. Potential desired conditions and implementation measures are described below for three levels:

- Level 1 – Standard ROW Vegetation Management
- Level 2 – Selective ROW Wire-Border Zone Vegetation Management
- Level 3 – Selective ROW Clearance Based Vegetation Management

In all settings, the Applicant must meet the NERC requirements and therefore, irrespective of the level of vegetation management applied, site-specific conditions may require a more conservative restrictive vegetation management approach such that the Applicant-defined minimum clearance to vegetation criteria, which complies with NERC, is met.

Level 1 - Standard ROW Vegetation Management

Application and Desired Condition. Level 1 is the Applicant's desired condition for the majority of the TWE Project ROW. Level 1 represents the most effective way to meet and exceed the NERC standards in a cost-effective manner. Level 1 would entail initially clearing the ROW of all undesirable vegetation and managing the ROW to maintain the desired condition.

The Level 1 desired condition is characterized by stable, low growth plant communities, free of noxious or invasive plants. These communities would typically be comprised of herbaceous plants and low growing shrubs, which ideally are native to the local area. Vegetation heights would average three feet in height, and may range between two feet and six feet. Accumulations of vegetation debris

from intensive or repetitive vegetation treatments may require mitigation to reduce risks from wildfire and enhance the fire survivability of the transmission facility. The density of remaining vegetation would be a consideration in assessing overall fire risk. Adequate access routes are required and must be maintained to provide for efficient, cost-effective vegetation treatment activities. Figures 21 and 22 illustrate the Level 1 desired conditions.

Implementation. As part of construction, the clearing of the ROW and access roads would be accomplished in accordance with a vegetation clearing specifications plan. As part of the ROW clearing, all danger trees would be identified and removed from the ROW. All trees would be cut off at ground level and the stumps left in place for erosion control. Low-growing trees, shrubs, and ground vegetation would be left in place to the extent possible. At ravine crossings, more woody vegetation would be retained to the extent practical with higher conductor clearances. Vegetation would be cleared at each tower. Clearance zones would extend out 50 feet around self supporting lattice towers and single shaft tubular steel poles. The clearance zone for the guyed lattice towers would extend out 20 feet from the outline of the guy pattern. Figure 23 shows the extents of vegetation clearing planned for the guyed lattice towers. Figure 24 provides comparable information for the tubular steel pole and self supporting lattice towers. Shrubs and ground cover outside these tower clearance zones would be left in place to the extent possible. Commercial timber generated from the ROW clearing would be purchased from the appropriate land management agency or private landowner. Slash would be removed from the Project site or chipped and spread according to approved USFS or BLM practices.

During the life of the TWE Project, the ROW would be managed to retain the Level 1 desired condition in designated areas. During operation, the Applicant would be responsible for routine inspections of vegetation. Annual plans for the inspection and treatment of vegetation would be implemented. The Plan would describe the methods used, such as manual clearing, mechanical clearing, herbicide treatment, or other actions.

Vegetation would be removed using mechanical equipment such as chain saws, weed trimmers, rakes, shovels, mowers, and brush hooks. Clearing efforts in heavy growth areas would use equipment such as a Hydro-Ax or similar. The duration of activities, and the size of crew and equipment required, would depend on the amount and size of the vegetation to be trimmed or removed. In selected areas, herbicides may be used to control noxious weeds and to meet vegetation management objectives. All herbicide applications would be performed in accordance with federal, state, and local regulations, and in compliance with appropriate land management agency or private landowner requirements.

Level 2 – Selective ROW Wire-Border Zone Vegetation Management

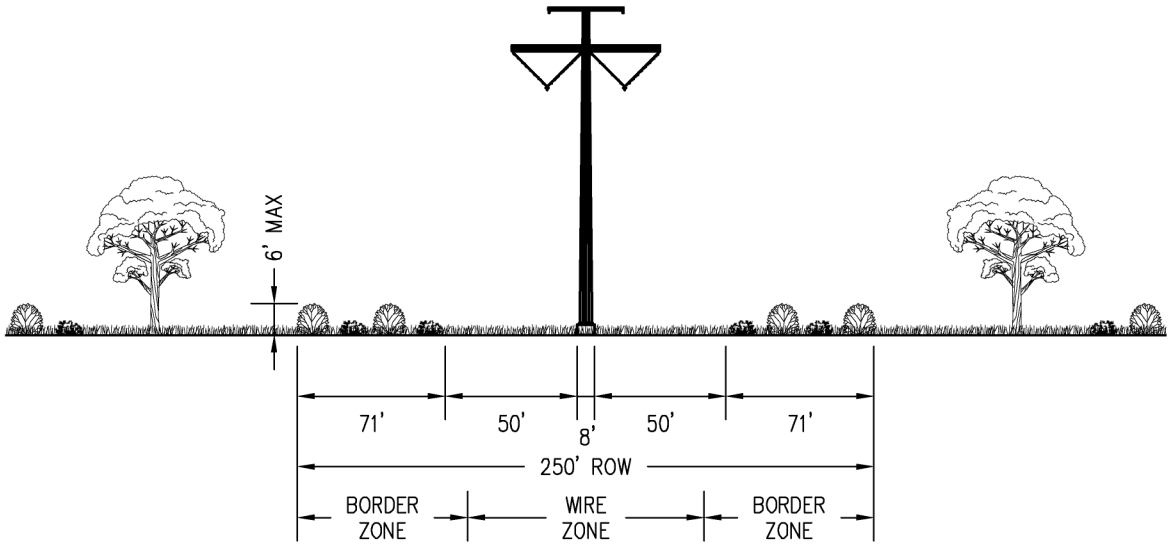
Application and Desired Condition. Level 2 is the desired condition for portions of the ROW where highly sensitive or constrained resource or agency management issues have been identified through the NEPA process that can be effectively mitigated with Level 2 vegetation treatment. Level 2 vegetation management would meet the NERC standards, but would be more costly in terms of on-going maintenance. Consequently, Level 2 would be applied selectively to only those portions of the ROW where the implementation of Level 2 would effectively mitigate potential impacts to highly sensitive resources. Examples of areas where Level 2 vegetation management may be appropriate are Visual Resource Management (VRM) Class III landscapes, or sensitive wildlife habitats susceptible to forest fragmentation impacts, where potential impacts can be effectively mitigated with this vegetation measure.

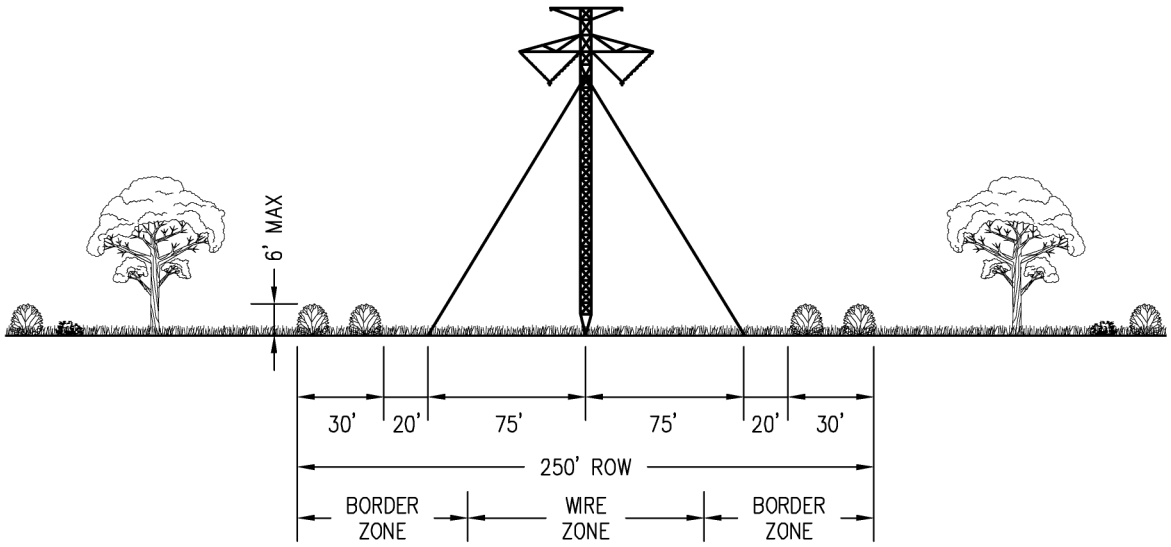
The desired condition of the ROW in Level 2 is based on the Wire Border Zone concept developed by Bramble and Brynes (Bramble, et al. 1985, 1986). The principle objective of the Wire Border Zone concept is to define a simple approach, based on maintaining a minimum clearance from an energized conductor to any type of vegetation, that can be applied to most situations on the transmission line This approach is consistent with the NERC FAC-003-2 regulatory requirements to maintain the required Minimum Vegetation Clearance Distance (MVCD).

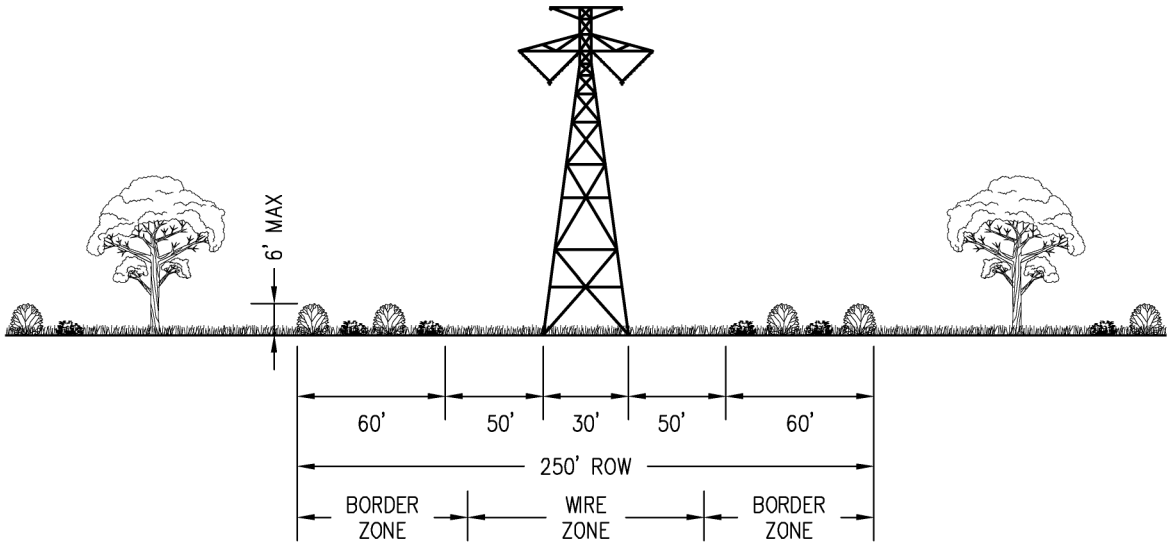
NERC FAC-003-2 defines the Wire-Border Zone as a technique that can be applied to the ROW through cultural control. Under this technique, two zones are defined for vegetation management. Figure 25 shows a typical ROW cross-section for the TWE Project ±600 kV DC transmission line and Wire Zone and Border Zone areas. The definition of each and desired conditions are as follows:

Wire Zone. The Wire Zone is defined as the section of the utility ROW that is directly under the wires and extending outward a distance sufficient to accommodate anticipated wire movement. The Wire Zone for this Project is 90 feet in width centered on the centerline of the transmission line. The maximum vegetation height for the desired conditions for Level 2 within the Wire Zone is six feet.

The desired condition for the Wire Zone would be the same as Level 1 and characterized by stable, low-growth plant communities, free of noxious or invasive plants. These communities would typically be comprised of herbaceous plants and low-growing shrubs, which ideally are native to the local area. Vegetation heights would average three feet in height, and may range between two feet and six feet. Refer to Level 1 for full definition.







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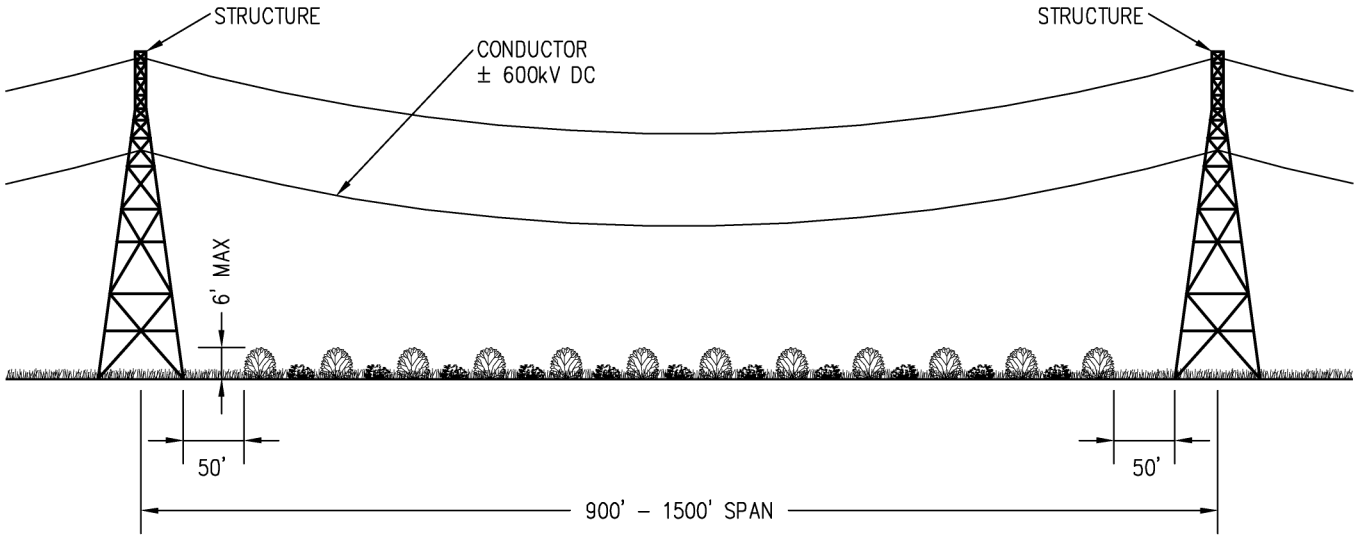
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 21

LEVEL 1 STANDARD ROW VEGETATION MANAGEMENT – CROSS SECTION VIEW



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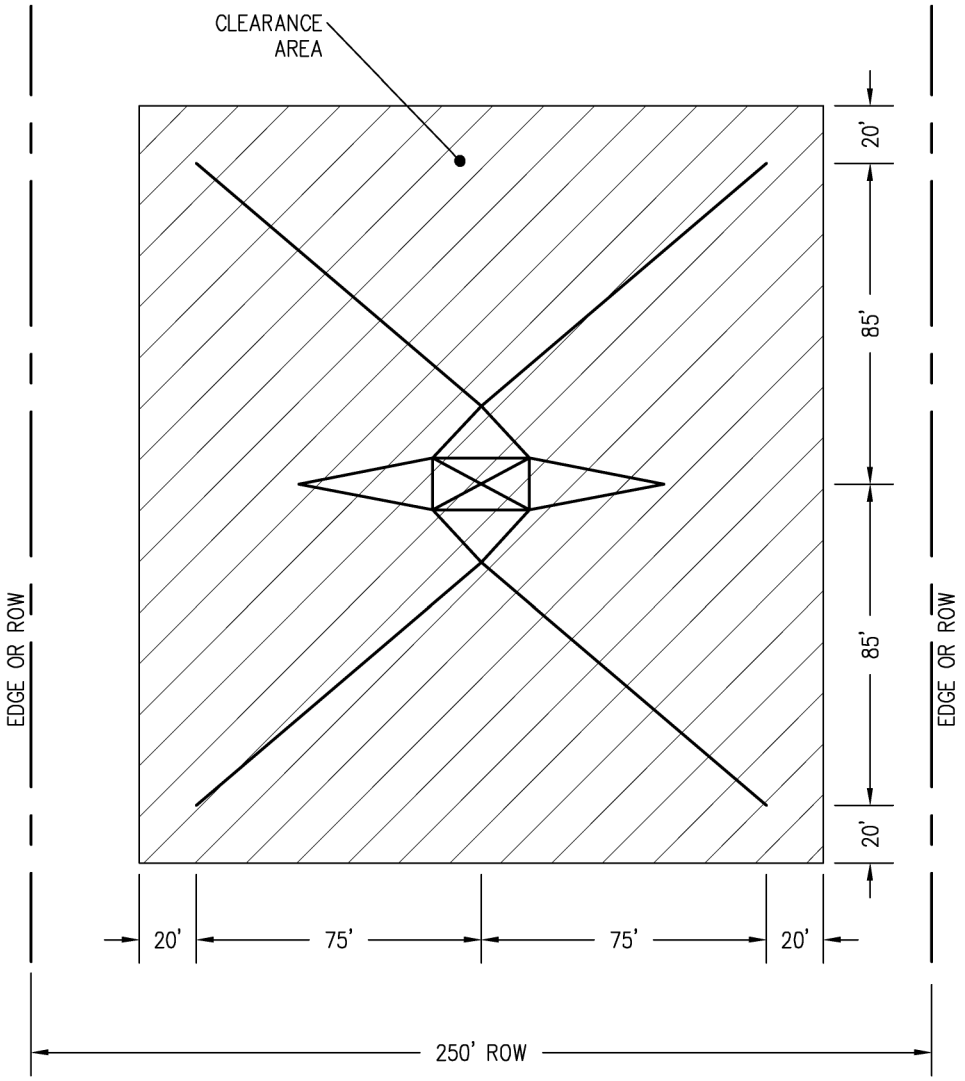
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 22

LEVEL 1 STANDARD ROW VEGETATION MANAGEMENT – PROFILE VIEW



CLEARANCE ZONE FOR GUYED LATTICE TOWER

(TYPICAL)

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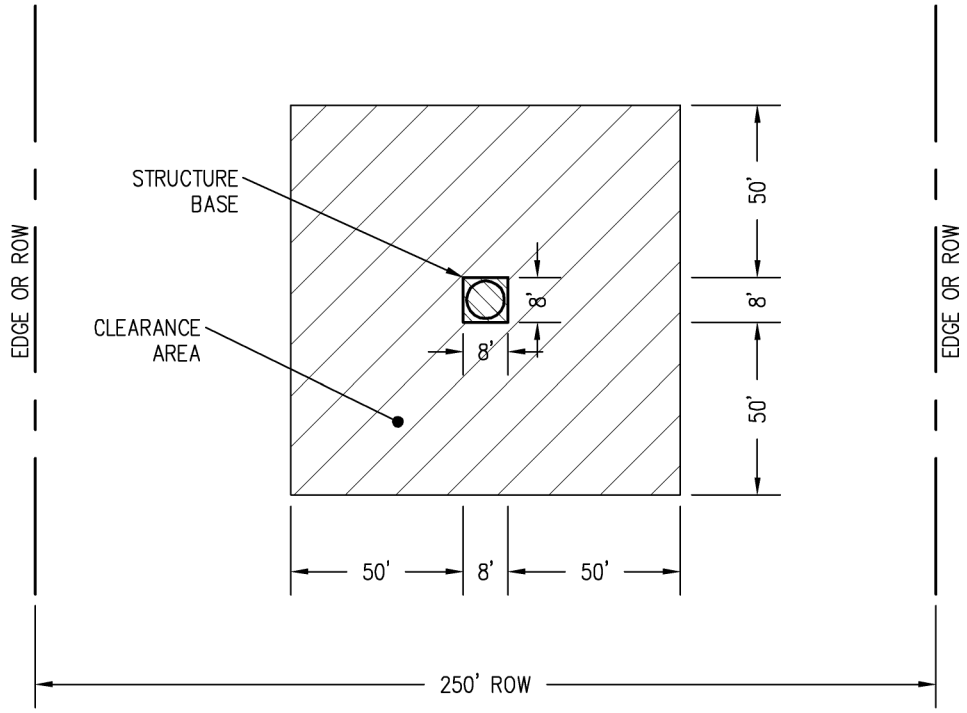
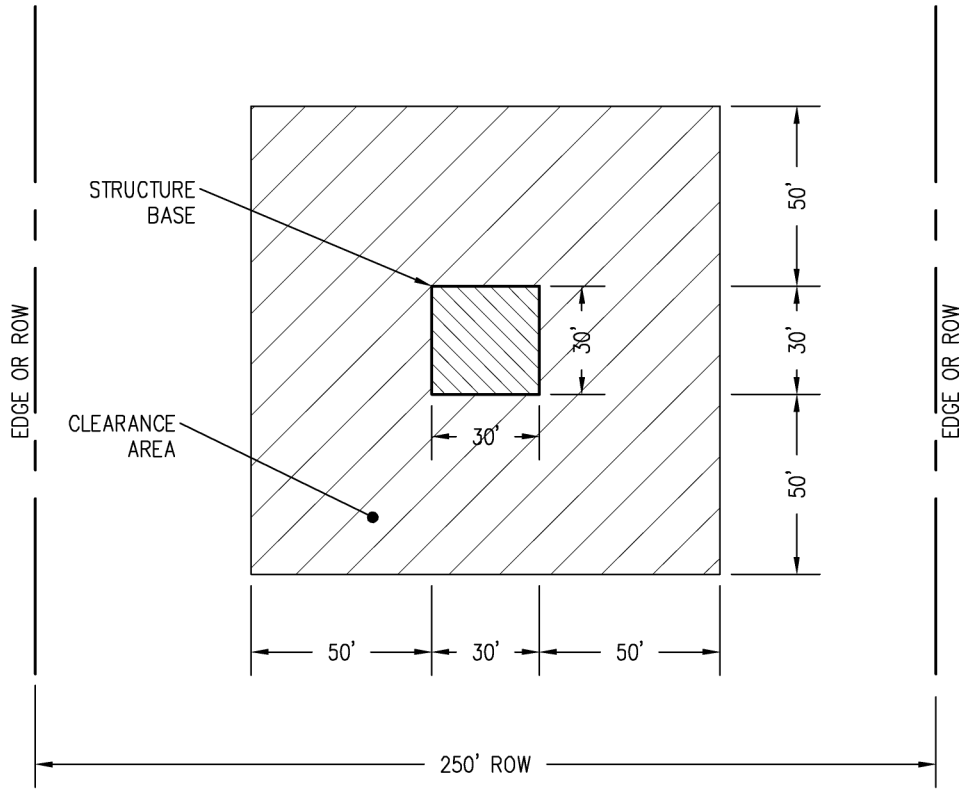
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 23

LEVELS 1, 2, & 3 VEGETATION CLEARANCE ZONE FOR GUYED STEEL LATTICE TOWER



CLEARANCE ZONE FOR TUBULAR STEEL POLE
(TYPICAL)



CLEARANCE ZONE FOR SELF-SUPPORTING LATTICE TOWER
(TYPICAL)

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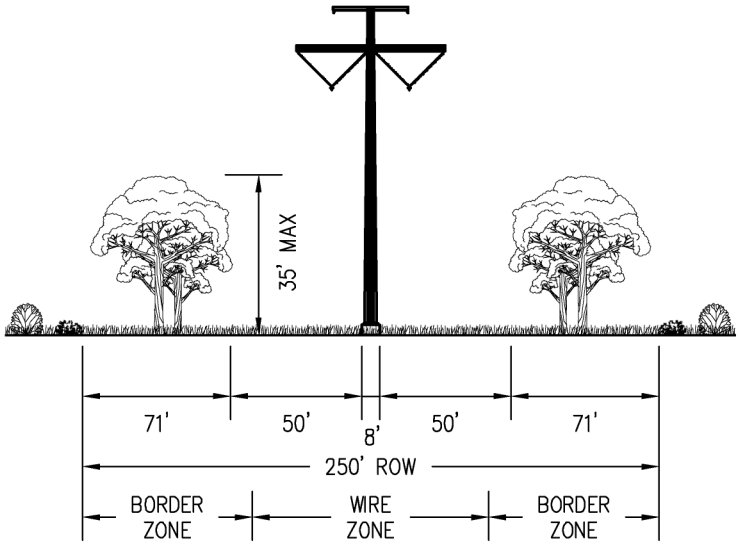
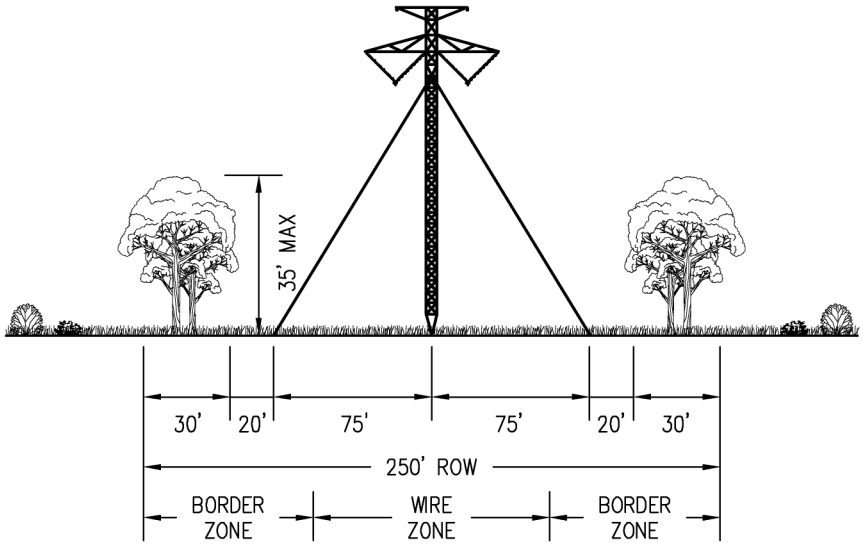
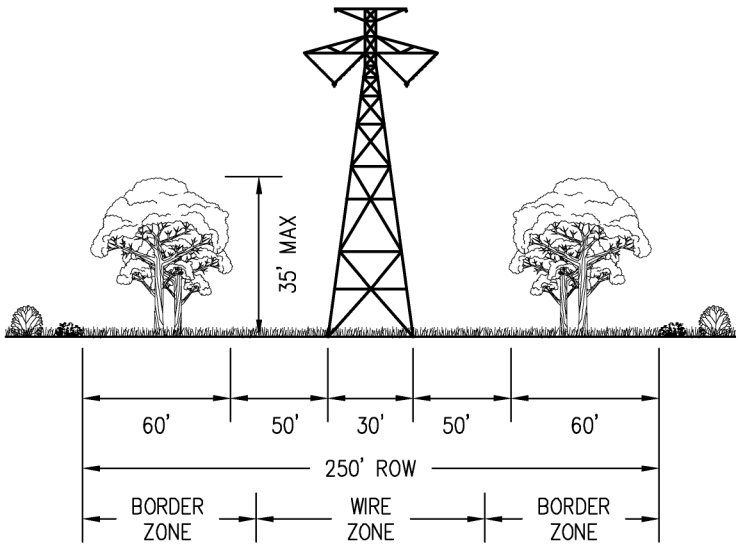
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 24

LEVELS 1, 2, & 3 VEGETATION CLEARANCE ZONE FOR TUBULAR STEEL POLE & SELF SUPPORTING STEEL LATTICE TOWER







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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 25

LEVELS 2 & 3 SELECTIVE ROW VEGETATION MANAGEMENT – CROSS SECTION VIEW

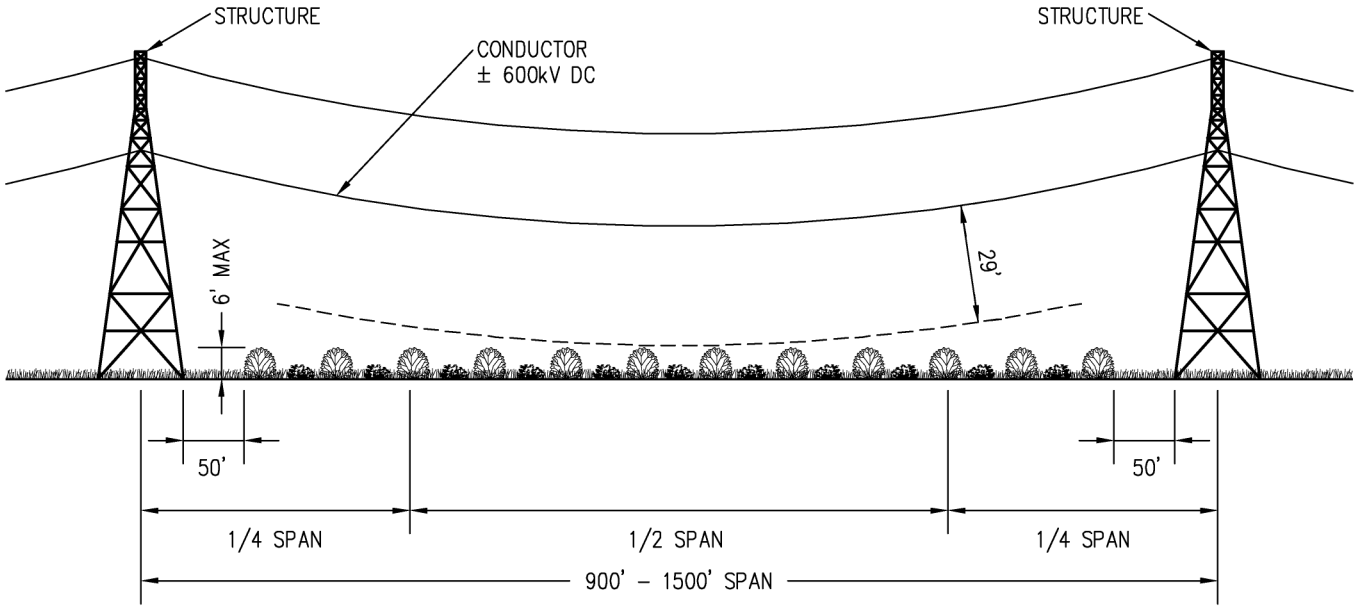
Border Zone. The Border Zone is defined as the section of the utility ROW that extends outward from Wire Zone boundary to the ROW boundary. For the TWE Project, the Border Zone would extend 80 feet on either side of the Wire Zone to the ROW boundary, depending on slope and other topographic conditions.

For Level 2, the desired condition within the Border Zone is to manage this section of the ROW for stable low-growth vegetation consisting of small trees and large shrubs, as well as lower grasses and herbs. The maximum vegetation height within the Border Zone, within the center half of the span is 25 feet. The maximum vegetation height within the Border Zone, within the quarter spans nearest the structures is 35 feet. Taller vegetation may also be suitable, depending on the growth and density characteristics of specific tree varieties, as well as increased height of the conductors across canyons or low-lying valleys. Figure 25 conceptually illustrates the differences in vegetation height that the Wire-Border Zone management technique would allow for each of the three structure types. Figures 26 and 27 illustrate a typical profile view of Level 2 vegetation heights.

Implementation. As part of construction, implementation standards for the clearing of the ROW and access roads would be the same in the Level 2 Wire Zone as described previously (refer to Level 1 discussion). Level 1 construction standards would also be applied to the Level 2 Border Zone in instances where undesirable vegetation needs to be removed and managed for the life of the Project (e.g., fast-growing or invasive species). Other techniques that may be used in the Level 2 Border Zone during construction are selective mechanical or manual tree removal, side pruning, and selective use of herbicides.

During operation, Level 2 vegetation would be managed the same as Level 1 in the Wire Zone. The Applicant would be responsible for routine inspections of vegetation. Annual plans for the inspection and treatment of vegetation would be implemented. The plan would describe the methods used, such as manual clearing, mechanical clearing, herbicide treatment, or other actions.

In the Border Zone, long-term operational practices would include additional techniques such as selective mechanical tree removal, selective manual control measures (e.g., use of hand-carried tools), and side pruning. Long-term operational management of ROW vegetation under Level 2 would be more costly and labor-intensive, over time, to ensure taller trees in the Border Zone do not violate NERC reliability standards for MVCD.



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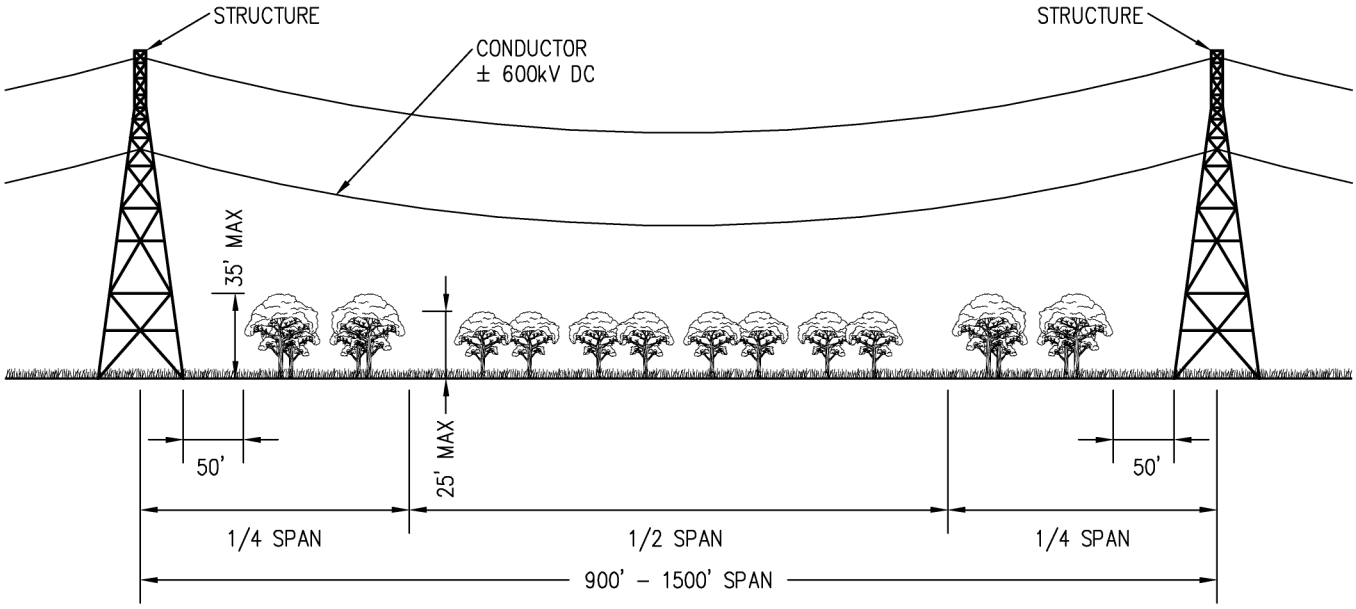
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 26

LEVEL 2 SELECTIVE ROW VEGETATION MANAGEMENT – WIRE ZONE PROFILE VIEW



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 27

LEVELS 2 & 3 SELECTIVE ROW VEGETATION MANAGEMENT – BORDER ZONE PROFILE VIEW

Level 3 – Selective ROW Clearance-Based Vegetation Management

Application and Desired Condition. Level 3 is the Applicant's desired condition for limited and selective portions of the ROW that have been determined to have critical resource or agency management issues associated with vegetation within the Wire Zone. Level 3 vegetation management would meet the NERC standards, but would be significantly more costly in terms of on-going maintenance of the ROW, would require more frequent access to the ROW, and more frequent vegetation treatments. Consequently, Level 3 is proposed by the Applicant only in limited and specific areas of the ROW where practices would effectively mitigate potential impacts to critical resources and related land management issues. Examples of critically sensitive areas where Level 3 vegetation management may be appropriate are at ROW crossings of riparian vegetation or VRM Class II areas where potential impacts can be effectively mitigated with this vegetation management practice.

Level 3 builds on the Level 2 desired conditions described above. The desired condition for Level 3 is based on maintaining the Applicant-defined minimum clearance from energized conductors to any type of vegetation. Within the Wire Zone and Border Zone, the Level 3 desired condition would allow for increased vegetation diversity and heights, where such vegetation would not pose potential conflicts with the Applicant-defined minimum clearances to vegetation.

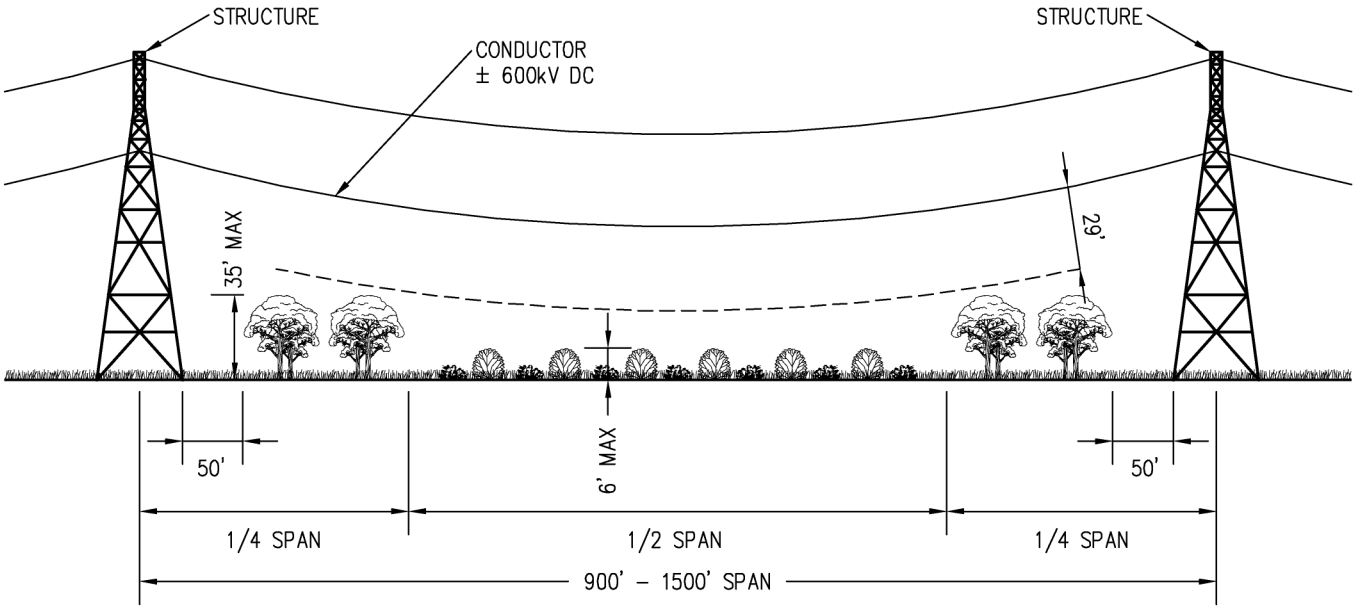
The Applicant-defined minimum clearances to vegetation have been established to incorporate NERC reliability standards, construction tolerances, conductor and tree movement due to wind and/or ice loading, increased sag as a result of thermal loading, and allowances for rapid vegetation growth. For the TWE Project, the minimum clearances from an energized conductor to vegetation would be:

- ±600 kV DC – 29 feet (at maximum elevation of 10,000 feet)
- 500 kV AC – 23 feet (at maximum elevation of 10,000 feet)

Under Level 3, increased vegetation heights anywhere within the ROW would be suitable where the vegetation does not encroach on the minimum clearance to vegetation established by the Applicant. Level 3 is also expected to be feasible at most ROW crossings of riparian vegetation due to increased structure heights at canyon crossings or low valley crossings. Level 3 vegetation management may also be achieved in some locations by increasing the height of structures at riparian crossings to allow a greater diversity and height of vegetation to remain.

For planning and determination of impacts purposes, the vegetation management for Level 3 should employ the Level 2 Border Zone definition described above. Figures 27 and 28 provide profiles for both the Wire and Border zones for Level 3.

Implementation. As part of construction, implementation standards for the clearing of the transmission structure sites and access roads within the ROW would be the same under Level 3 as previously described for Level 1 (refer to Level 1 discussion).



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 28

LEVEL 3 SELECTIVE ROW VEGETATION MANAGEMENT – WIRE ZONE PROFILE VIEW

In practice, Level 3 selective clearing of the entire ROW would be defined on a span-by-span basis such that any vegetation that does not meet the minimum clearance to vegetation established by the Applicant would be cleared. Level 3 construction standards would be applied in instances where undesirable vegetation needs to be removed from the ROW and managed for the life of the Project (e.g., fast-growing or invasive species). Selective clearing techniques that may be used for Level 3 clearance criteria during construction are selective mechanical tree removal, side pruning, and selective use of herbicides. In general, trees and larger shrubs would be retained through selective clearing.

During operation, Level 3 vegetation would be managed within the ROW to maintain the desired conditions. Long-term operational practices for Level 3 ROW areas would be more labor-intensive and expensive than Level 1 or 2, to ensure that, over time, taller trees and shrubs do not violate the Applicant-defined minimum clearances to vegetation. Level 3 also requires more frequent visitation and access to the ROW for inspections and vegetation treatments.

During operation, the Applicant would be responsible for routine inspections of vegetation. Annual plans for the inspection and treatment of vegetation would be implemented. The Plan would describe the methods to be used in Level 3 areas, as well as techniques applicable to the Level 1 and 2 portions of the ROW.

Appendix C summarizes how the TWE Project vegetation management program improvement levels would apply to each of the vegetation communities identified in AECOM's Memorandum, dated February 22, 2011 (AECOM 2011). Appendix C shows photographs of existing Western ROWs that characterize the Level 3 management vegetation strategies.

3.6.3 Terminals, Substation, Ground Electrodes and Communication Systems

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

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

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

Each of the terminals will have a control room staffed 24 hours per day, 365 days per year by two to three system operators and supervisory personnel. In addition to control room staffing, 8 to 20 technicians, engineers, maintenance, security, and supervisory personnel may be staffed at each terminal. Total staffing at each terminal is expected to be 20 to 30 people.

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

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

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

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

3.6.3.1 Water Use

Operation and maintenance of the Northern and Southern Terminals is expected to require water use by personnel in the Operations and Maintenance office building and by the HVDC evaporative cooling and misting systems during summer months. Monthly and annual estimated water use is provided in Table 8.

TABLE 8 NORTHERN AND SOUTHERN TERMINAL ANNUAL ESTIMATED WATER USE (ALL VALUES IN ACRE-FEET)

MONTH	OFFICE USE	COOLING & MISTING SYSTEMS FOR N. TERMINAL	COOLING & MISTING SYSTEMS FOR S. TERMINAL	TOTAL USE N. TERMINAL	TOTAL USE S. TERMINAL
January	0.069	0	0	0.069	0.069
February	0.062	0	0	0.062	0.062
March	0.069	0	0	0.069	0.069
April	0.066	0	0	0.066	0.066
May	0.069	0	0.034	0.069	0.103
June	0.066	0.068	0.068	0.134	0.134
July	0.069	0.135	0.135	0.205	0.205
August	0.069	0.068	0.135	0.137	0.204
September	0.066	0	0.068	0.066	0.134
October	0.069	0	0	0.069	0.069

TABLE 8 NORTHERN AND SOUTHERN TERMINAL ANNUAL ESTIMATED WATER USE (ALL VALUES IN ACRE-FEET)					
MONTH	OFFICE USE	COOLING & MISTING SYSTEMS FOR N. TERMINAL	COOLING & MISTING SYSTEMS FOR S. TERMINAL	TOTAL USE N. TERMINAL	TOTAL USE S. TERMINAL
November	0.066	0	0	0.066	0.066
December	0.069	0	0	0.069	0.069
Annual	0.809	0.272	0.44	1.081	1.25
Source: BBA 2012					

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

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

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

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

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

3.6.4 Emergency Response

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

The implementation of routine operation and maintenance activities on power lines minimize the need for most emergency repairs. Emergency maintenance activities are often those activities necessary to repair natural hazard, fire, or human-caused damages to a line. Such work is required to eliminate a

safety hazard, prevent imminent damage to the power line, or restore service if there is an outage. In an emergency, the Applicant must respond as quickly as possible to restore power.

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

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

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

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

3.6.5 Fire Protection

All federal, state, and county laws, ordinances, rules, and regulations pertaining to fire prevention and suppression would be strictly adhered to. All personnel would be advised of their responsibilities under the applicable fire laws and regulations.

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

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

within designated roads or work areas, and providing fire suppression equipment and emergency notification numbers at each construction site.

3.6.6 ROW Safety Requirements

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

3.6.7 Building and Fence Grounding

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

3.6.8 Decommissioning Practices

The proposed transmission line would have a projected operational life of at least 50 years or longer. At the end of the useful life of the Project and if the facility were no longer required, the transmission line would be removed from service. At such time, 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 terminal, substation, or regeneration station is no longer required, the buildings, structures and equipment would be dismantled and removed from the site. The station structures would be disassembled and either re-used at another station or sold for scrap. Major equipment such as breakers, transformers, and reactors would be removed, refurbished, and stored for use at another facility. Foundations would be either abandoned in-place or cut off below ground level and buried.

For access roads serving the transmission line, the Applicant is responsible for the decommissioning and reclamation of access roads following abandonment in accordance with the landowner's or land agency's direction.

3.7 TWE Project Environmental Mitigation Measures

Prior to construction, the Applicant will prepare a COM Plan, which will incorporate environmental measures, stipulated in the Lead Agencies' Records of Decision(s) (RODs). The COM Plan will provide information on the TWE Project design, construction, operation, and maintenance practices, and environmental mitigation measures that will be used and implemented by contractors and personnel.

The following is a preliminary list of specific plans, which will be incorporated into the COM Plan:

- Access Road Plan
- Biological Protection Plan
- Blasting Plan
- Clean-up Work Management Plan
- Cultural Resources Treatment Plan
- Erosion, Dust Control and Air Quality Plans
- Fire Protection Plan
- Flagging, Fencing and Signage Plan
- Hazardous Materials Management Plan
- Health and Safety Plan
- Mitigation Monitoring Plan
- Noxious Weed Management Plan
- Paleontological Resources Management and Mitigation Plan
- Pesticide Use Plan
- ROW Preparation, Rehabilitation, and Restoration Plan
- Spill Prevention Notification and Clean Up Plan
- Storm Water Pollution Prevention Plan
- Vegetation Management Plan
- Wetlands and Waters of the U.S. Mitigation Plan (CWA, Section 404 Permit)

The COM Plan will include the TWE Project-committed mitigation measures. Mitigation measures include general mitigation measures, which would apply to the TWE Project as a whole; and selective mitigation measures, which would be implemented on a case-by-case basis to address specific environmental impacts or localized conditions. The mitigation measures will be updated through the NEPA process to incorporate appropriate selective mitigation measures.

Table 9 identifies the general mitigation measures, which will be used to reduce impacts to environmental resources. Mitigation measures are organized by major resource topics. These measures are part of the proposed TWE Project, and would be common to all the DEIS alternatives. Table 9 identifies the phase(s) during which each measure would be implemented:

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

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

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			wherever possible.
9	C, O	Access	All construction vehicle movement outside the ROW normally will be restricted to pre-designated access or public roads.
10	P, C	General ROW, visual	The area limits of construction activities will normally be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents will be applied to rocks or vegetation to indicate survey or construction activity limits.
11	P, C	Access, visual	In construction areas where re-contouring is not required, vegetation will be left in place, wherever possible, and original contour will be maintained to avoid excessive root damage and to allow for re-sprouting.
12	P, C, O	Access, soils, vegetation, water, cultural visual resources	Except for repairs necessary to make roads passable, no widening or upgrading of existing access roads will be undertaken in the area of construction and operation, where soils or vegetation are sensitive to disturbance. In designated areas, structures will be placed to avoid sensitive features such as, but not limited to, riparian areas, water courses and cultural sites, or to allow conductors to clearly span the features within limits of standard structure design. This will minimize the amount of disturbance to the sensitive feature or reduce visual contrast.
13	C	Vegetation management, restoration, erosion control	In construction areas (e.g., marshalling yards, structure sites, spur roads from existing access roads) where ground disturbance is significant or where re-contouring is required, surface restoration will occur as required by the landowner or land management agency. The method of restoration will normally consist of returning disturbed areas back to their natural contour, reseeding (if required), installing cross drains for erosion control, placing water bars in the road, and filling ditches.
14	P, C	General, soils, erosion control, visual	The COM Plan will show the location of borrow sites, from which material will be obtained. Borrow pits will be stripped of topsoil to a depth of approximately six inches. Stripped topsoil will be stockpiled and, upon completion of borrow excavation, spread to a uniform depth of six inches over areas of borrow pits from which removed. Before replacing topsoil, excavated surfaces will be reasonably smooth and uniformly sloped. The sides of borrow pits will be brought to stable slopes with slope intersection shaped to carry the natural contour of adjacent undisturbed terrain into the pit to give a natural appearance. When necessary, borrow pits will be drained by open ditches to prevent accumulation of standing water.
15	C	Clean-up	The COM Plan will include a Clean-up Work Management Plan, and a Flagging, Fencing, and Signage Plan. Except for permanent survey markers, and material that locate proposed facilities, stakes, pins, rebar, spikes, and other material will be removed from the surface and within the top 15 inches of the topsoil as a part of final clean-up. Fences on ROW will be removed where necessary and replaced to the original condition or better when the work is finished. Where existing fences are removed to facilitate the work, temporary fence protection for lands adjacent to the ROW will be provided at all times during the continuation of the Contract. Such temporary fence protection will be adequate to prevent public access to restricted areas. Temporary fencing constructed on the ROW will be removed by the Contractor as part of the clean-up operations prior to final acceptance of the completed work.

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
16	C	Site restoration and clean-up, water resources, land use	Watering facilities (tanks, natural springs and/or developed springs, water lines, wells, etc.) will be repaired or replaced, if damaged or destroyed by construction activities, to their pre-disturbed condition as required by the landowner or land management agency.
17	C	Site restoration and clean-up	Existing vegetation such as landscape plants, gardens, and field crops, which are damaged by the application of the soil-applied herbicide, will be replaced by the Contractor at its expense.
18	C	Site clean-up	The Applicant will pay fair market value to the land management agency for any merchantable forest products that will be cut during ROW clearing. Merchantable forest products will either be removed or stacked at locations determined by the land management agency.
GEOLOGY AND SOILS			
19	C	Drainage, soil erosion control	The COM Plan will include an Erosion Control Plan. Grading will be performed to provide adequate drainage around structure sites and sufficient clearance under conductors. Excavated material will be spread around the site from which excavated. Topsoil will be piled separately and replaced after work completion.
GROUNDWATER, SURFACE WATER AND WETLANDS			
20	P	Water quality	As part of the CWA 404 Permit for the TWE Project, the COM Plan will include a Wetlands and Waters of the U.S. Plan, which will incorporate measures to avoid and minimize impacts to wetlands and waters of the U.S. to the extent practical. The COM Plan will include a Storm Water Pollution Prevention Plan. The Applicant will identify all streams in the vicinity of the proposed project sites that are listed as impaired under Section 303(d) of the CWA and develop a management plan to avoid, reduce, and/or minimize adverse impacts to those streams.
21	P	Water quality	The Applicant will obtain a National Pollutant Discharge Elimination System (NPDES) permit from the Environmental Protection Agency (EPA) prior to construction.
22	C	Water quality	Runoff from excavated areas, construction materials or wastes (including truck washing and concrete washes), and chemical products such as oil, grease, solvents, fuels, and pesticides will be controlled. Excavated material or other construction material will not be stockpiled or deposited near or on stream banks, lake shorelines, ditches, irrigation canals, or other areas where runoff could impact the environment.
23	C	Water quality	Washing of concrete trucks or disposal of excess concrete in any ditch, canal, stream, or other surface water will not be permitted. Concrete wastes will be disposed of in accordance with all federal, state and local regulations.
24	C, O	Surface water, wetlands	Vehicle refueling and servicing activities will be performed in designated construction zones located more than 100 feet from wetlands and streams. Spill prevention and containment measures or practices will be incorporated as needed.
25	P	Dewatering	A dewatering permit will be obtained from the appropriate agencies if required for construction dewatering activities.
VEGETATION AND SOILS MANAGEMENT			
26	P, C	Vegetation management and noxious weeds	The COM Plan will include a Vegetation Management Plan and a Noxious Weed Management Plan. The Vegetation Management Plan will address plant removal and selective clearing. The Noxious Weed Management Plan

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			will be developed in accordance with appropriate land management agencies' standards, consistent with applicable regulations and agency permitting stipulations for the control of noxious weeds and invasive species (Executive Order (E.O.) 13112). Included in the Noxious Weed Management Plan will be stipulations regarding construction, restoration, and operation (use of weed-free materials, washing of equipment, etc.).
27	C	Vegetation management	In construction areas where re-contouring is not required, vegetation will be left in place wherever possible and original contour will be maintained to avoid excessive root damage and allow for re-sprouting.
28	C	Vegetation management, visual	Clearing will be performed so as to minimize marring and scarring the countryside and preserve the natural beauty to the maximum extent possible. Except for danger trees, no clearing will be performed outside the limits of the ROW.
ECOLOGICAL RESOURCES			
29	P, C	Ecological, special status species	The COM Plan will include a Biological Protection Plan, which will identify important, sensitive, or unique habitats and BLM sensitive, USFS sensitive, and state-listed species in the vicinity of the TWE Project. The COM Plan will identify measures to be taken to avoid, minimize, or mitigate impacts to these habitats and species.
30	P	Ecological, raptors	In applicable areas, the TWE Project will be designed to meet or exceed the raptor safe design standards described in the *Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006* (Avian Power Line Interaction Committee (APLIC) 2006).
31	P, C, O	Ecological, special status species	Mitigation measures that will be developed during the consultation period with the BLM and under Section 7 of the ESA will be adhered to, along with mitigation developed in conjunction with state authorities.
32	P, C	Ecological, special status species	Seasonal restrictions may be implemented in certain areas to mitigate impacts on wildlife. With the exception of emergency repair situations, ROW construction, restoration, maintenance, and termination activities in designated areas will be modified or discontinued during sensitive periods (e.g., nesting and breeding periods) for candidate, proposed or listed threatened and endangered, or other sensitive animal species, as required by permitting agencies. Potential seasonal restrictions and avoidance buffers for nesting raptors will be identified in the DEIS. The Biological Protection Plan will incorporate the seasonal restrictions and stipulations contained in the federal agency RODs.
33	P, C	Ecological, special status species and habitats	Prior to the start of construction, the Applicant will provide training to all Contractor and Subcontractor personnel and others involved in construction activities where/if there is a known occurrence of protected species or habitat in the construction area. Sensitive areas will be considered avoidance areas. Prior to any construction activity, avoidance areas will be marked on the ground and maintained through the duration of the Contract. The Applicant will remove markings during or following final inspection of the Project.
34	C	Ecological, special status species and habitats	If evidence of a protected species not previously identified or known is found in the Project area, the Contractor will immediately notify the appropriate land management agencies and provide the location and nature of the findings.
CULTURAL RESOURCES – HISTORIC, ARCHAEOLOGICAL, AND TRIBAL TRADITIONAL			

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
35	P, C	Cultural resources	In consultation with the appropriate land management agencies and state historic preservation officers (SHPOs), and in accordance with the Programmatic Agreement (PA), a Cultural Resources Treatment Plan will be prepared as part of the COM Plan to address the specific mitigation measures for cultural resources that will be developed and implemented to mitigate any identified adverse effects. These may include Project modifications to avoid adverse impacts, monitoring of construction activities, and data recovery studies.
36	P, C	Native American cultural resources	The Applicant will comply with all laws, policies, and regulations pertaining to consultations with federally recognized Tribes.
37	P	General, cultural	Prior to construction, all construction personnel will be instructed on the protection of cultural resources, including the provisions of federal, state, and tribal laws regarding cultural resources, including prohibition of collection and removal; and the importance of these resources and the purpose and necessity of protecting them.
PALEONTOLOGICAL RESOURCES			
38	P, C, O	Paleontology	If paleontological resources are known to be present in the Project area, or if areas with a high potential to contain paleontological material has been identified through the NEPA process and DEIS, the Applicant will prepare a Paleontological Resources Management and Mitigation Plan as part of the COM Plan.
39	P	Paleontology	Paleontological mitigation may be required in areas of greatest disturbance and areas likely to have significant fossils. Preconstruction surveys of such areas may be conducted as agreed upon by the land-managing and lead federal agency.
LAND USE AND VISUAL RESOURCES			
40	P, C, O	Land Use, agriculture	On agricultural land, the ROW will be aligned, in so far as practical, to reduce the impacts to farm operations and agricultural production.
41	C	Land Use, agriculture	In cultivated agricultural areas, soil compaction by construction activities will be disked to uncompacted soils. Construction activities will minimize impacts on agricultural operations.
42	C	Land Use, ranching	In grazing areas, excessive amounts of pine needles left by clearing of trees, will be removed from the ROW and disposed of in a location to prevent harm to grazing domestic animals.
43	C	Access, land use, gates	The COM Plan will include a Flagging, Fencing, and Signage Plan. Fences and gates will be repaired or replaced to their original pre-disturbed condition as required by the landowner or the land management agency if they are damaged or destroyed by construction activities. Temporary gates will be installed only with the permission of the landowner or the land management agency, and will be restored to their original pre-disturbed condition following construction. Cattle guards will be installed where new permanent access roads cut through fences, at the request of the land management agency.
44	P, C, O	Visual	Non-specular conductors and shield/ground wires will be used to reduce potential visual impacts.
45	P, C, O	Structure design and public safety	Structures and/or shield/ground wire will be marked with high-visibility devices where required by governmental agencies (Federal Aviation Administration (FAA)). Structure heights will be less than 200 feet, where feasible, to minimize the need for aircraft obstruction lighting.

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
46	P, C, O	Visual resources	The Applicant will comply with federal permitting agency stipulations regarding visual resources.
			AIR QUALITY
47	P, C	Air quality, dust control	The COM Plan will include a Dust Control and Air Quality Plan. Requirements of those entities having jurisdiction over air quality matters will be adhered to and dust control measures will be developed. Open burning of construction trash will not be allowed unless permitted by appropriate authorities.
48	P, C	Air quality, emissions	The Contractor and Subcontractor(s) will be required to have and use air emissions control devices on construction machinery, as required by federal, state or local regulations or ordinances.
			CORONA EFFECTS
49	P, C, O	Corona	Transmission line materials will be designed to minimize corona. The proposed hardware and conductor will limit the audible noise, radio interference, and TV interference due to corona. Tension will be maintained on all insulator assemblies to assure positive contact between insulators, thereby avoiding sparking. Caution will be exercised during construction to avoid scratching or nicking the conductor surface that may provide points for corona to occur.
50	O	TV, radio interference	The Applicant will respond to complaints of line-generated radio or television interference by investigating the complaints and implementing appropriate mitigation measures. The transmission line will be patrolled on a regular basis so that damaged insulators or other line materials that could cause interference are repaired or replaced.
			PUBLIC HEALTH AND SAFETY
51	P, C, O	Safety standards	The TWE Project will be designed, constructed, and operated to meet or exceed the requirements of the National Electrical Safety Code (NESC), U.S. Department of Labor, Occupational Safety and Health Administration standards, and the Applicant's requirements for safety and protection of landowners and their property.
52	O	Induced currents	The Applicant will apply necessary mitigation to eliminate problems of induced currents and voltages onto conductive objects sharing ROW, to the mutual satisfaction of the parties involved.
53	P, C	Blasting	The COM Plan will include a Blasting Plan, which will identify methods and mitigation measures to minimize the effects of blasting, where applicable. The Blasting Plan will document the proposed methods to achieve the desired excavations, proposed methods for blasting warning, use of non-electrical blasting systems, and provisions for controlling fly rock, vibrations, and air blast damage.
54	P, C, O	Noise, electrostatic, and EMF	Research studies performed to determine the effects of audible noise and electrostatic and electromagnetic fields (EMF) will be regularly monitored by the Applicant to ascertain whether these effects are significant.
55	P, C, O	FAA regulations	The TWE Project will be designed to comply with FAA regulations, including lighting regulations, to avoid potential safety issues associated with proximity to airports, military bases or training areas, or landing strips.
56	P	Worker health and safety	As part of the COM Plan, the Applicant will provide a Health and Safety Plan, which will outline measures to protect workers and the general public during construction, operation, and decommissioning of the TWE Project. The Plan will identify applicable federal and state occupational safety standards,

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			establish safe work practices, and define safety performance standards.
		HAZARDOUS MATERIALS, WASTE, AND WASTEWATER MANAGEMENT	
57	P	Hazardous materials	As part of the COM Plan, the Applicant will provide a Spill Prevention Notification and Clean-up Plan. The Plan will address compliance with all applicable federal, state, and local regulations, and will include: spill prevention measures, notification procedures in the event of a spill, employee awareness training, and commitment of manpower, equipment, and materials to respond to spills, if they occur.
58	P	Hazardous materials	As part of the COM Plan, the Applicant will provide a Pesticide Use Plan. The Plan will address compliance with all applicable federal, state and local regulations.
59	P	Hazardous materials	As part of the COM Plan, the Applicant will provide a Clean-up Work Management Plan that has been approved by applicable federal, state or local environmental regulation agencies. The plan will address on-site excavation of contaminated soils and debris and will include: identification of contaminants, methods of excavation, personnel training, safety and health procedures, sampling requirements, management of excavated soils and debris, and disposal methods.
60	C	Waste management	No non-biodegradable debris will be deposited in the ROW. Slash and other biodegradable debris will be left in place or disposed of in accordance with agency requirements.
61	C, O	Hazardous materials, waste management	As part of the COM Plan, the Applicant will provide a Hazardous Materials Management Plan. Hazardous materials will not be drained onto the ground or drainage areas. Totally enclosed containment will be provided for all trash. All construction waste including trash and litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials will be removed to a disposal facility authorized to accept such materials.
62	C, O	Hazardous materials	If a reportable release of hazardous substance occurs at the work site, the Contractor will immediately notify the Applicant and all environmental agencies, as required by law. The Contractor will be responsible for the clean-up.
		FIRE PROTECTION	
64	P, C	Fire, safety	The COM Plan will include a Fire Protection Plan. The Applicant or its Contractor(s) will notify the BLM of any fires and comply with all rules and regulations administered by the BLM and USFS concerning the use, prevention, and suppression of fires on federal lands, including any fire prevention orders that may be in effect at the time of the permitted activity. The Applicant or its Contractor(s) may be held liable for the cost of fire suppression, stabilization, and rehabilitation. In the event of a fire, personal safety will be the first priority of the Applicant or its Contractor(s). The Applicant or its Contractor(s) will: • Operate all internal and external combustion engines on federally-managed lands per 36 CFR 261.52(j), which requires all such engines to be equipped with a qualified spark arrester that is maintained and not modified; • Carry shovels, water, and fire extinguishers that are rated at a minimum as ABC-10 pound on all equipment and vehicles. If a fire

TABLE 9 TWE PROJECT COMMITTED ENVIRONMENTAL MITIGATION MEASURES			
NO.	PHASE(S)	TOPIC	DESCRIPTION OF MITIGATION MEASURE
			spreads beyond the suppression capability of workers with these tools, all workers will cease fire suppression action and leave the area immediately via pre-identified escape routes; • Initiate fire suppression actions in the work area to prevent fire spread to or on federally-administered lands. If fire ignitions cannot be prevented or contained immediately, or it may be foreseeable that a fire would exceed the immediate capability of workers, the operation must be modified or discontinued. No risk of ignition or re-ignition will exist upon leaving the operation area; • Notify the appropriate fire center immediately of the location and status of any escaped fire; • Review weather forecasts and the potential fire danger prior to any operation involving potential sources of fire ignition from vehicles, equipment, or other means. Prevention measures to be taken each workday will be included in the specific job briefing. Consideration will be given to additional mitigation measures or temporary discontinuance of the operation during periods of extreme wind and dryness; • Operate all vehicles on designated roads, or park in areas free of vegetation; • Operate welding, grinding, or cutting activities in areas cleared of vegetation within range of the sparks for that particular action. A spotter will be required to watch for ignitions; and • Use only diesel-powered vehicles in areas where excessive heat from vehicle exhaust systems could start brush or grass fires.

4.0 TWE PROJECT ALTERNATIVES

Section 4.0 describes the range of alternatives presented during the TWE Project Public Scoping process. In January 2011, the BLM and Western issued the Notice of Intent (NOI) to prepare an Environmental Impact Statement (EIS) for the TWE Project. The NOI was published in the Federal Register on January 4, 2011 starting the 90-day public scoping process. The joint lead agencies held 23 scoping meetings in Wyoming, Colorado, Utah and Nevada.

Section 4.0 provides information on siting areas and alternative facility locations for the TWE Project terminals and ground electrode systems, which have been developed by TransWest for the lead agencies consideration. Section 4.0 also discusses the feasibility of undergrounding portions of the TWE Project, in response to the lead agencies' request for information on this technology alternative.

Section 4.0 describes alternatives to the proposed TWE Project as follows:

- Section 4.1 – Transmission Line Alternatives, describes the alternative line design characteristics, structure designs, and construction, operation and maintenance practices for the corridor routing alternatives.

- Section 4.2 – Project Facility Alternatives, describes the general siting areas, and proposed and alternative facility locations for the Northern and Southern Terminals and ground electrode systems. These alternatives are recommended by TransWest for inclusion in the DEIS.

- Section 4.3 – System Alternatives, describes system alternatives presented during public scoping. The system alternatives, termed System Alternative 1, 2 and 3, were initially suggested by TransWest in the *TransWest Express Transmission Project ROW Application SF 299 (Amended from December 2008) January 2010* (TWE 2010b). System Alternative 1 was removed from further consideration as described previously in Section 2.4.2. System Alternatives 2 and 3 are recommended by TransWest for inclusion in the DEIS.

- Section 4.4 – Undergrounding Alternative, describes technology and feasibility issues associated with undergrounding portions of the TWE Project. TransWest is not recommending this technology alternative be considered in detail in the DEIS. Technical issues associated with potential undergrounding alternatives are discussed.

4.1 Transmission Line Alternatives

4.1.1 Transmission Line Design Alternatives

The transmission line design characteristics and alternative structure designs would be the same for the corridor routing alternatives as previously described for the proposed TWE Project in Section 3.1.

4.1.2 Transmission Line Construction, Operation and Maintenance Practices

The construction, operation and maintenance practices for the corridor routing alternatives would be the same as previously described for the proposed TWE Project in Sections 3.5 and 3.6.

4.2 Project Facility Alternatives

4.2.1 Northern Terminal

The location for the Northern Terminal will be finalized during engineering and design. The general planned location for the Northern Terminal is proposed to be within a general siting area, shown on Map Exhibit 3. For purposes of the DEIS analysis, Map Exhibit 3 shows a preliminary location for the Northern Terminal and its relationship to the TWE Project proposed corridor and grid interconnections. Considerations in siting the location of the Northern Terminal within this general area include:

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

4.2.2 Southern Terminal

The location for the Southern Terminal will be finalized during engineering and design. The location for the Southern Terminal is proposed to be within a general siting area, shown on Map Exhibit 4. For purposes of the DEIS analysis, Map Exhibit 4 shows preliminary locations for the Southern Terminal and its relationship to the TWE Project proposed corridor and grid interconnections. Siting criteria used in selecting this siting area, and the final site location are similar to those described for the Northern Terminal.[11]

4.2.3 Ground Electrode System Alternatives

The location of the ground electrode systems will be finalized during engineering and design. For purposes of the DEIS analysis, general siting areas and conceptual site locations have been identified for the proposed and alternative northern and southern ground electrode systems as shown on Map Exhibits 5 and 6. The ground electrode site could be located anywhere within the siting areas. Additionally, for the DEIS analysis, the lower voltage connector lines from the ±600 kV DC transmission line proposed route to each of the conceptual ground electrode sites are shown on Map Exhibits 5 and 6.

The proposed TWE Project and alternative siting areas were selected based on feasibility studies that considered surface and deep earth geology, proximity to the proposed and alternative routes,

[11] Criteria are the same, except interconnections with the planned Energy Gateway Projects do not apply to the Southern Terminal.

proximity to underground infrastructure (oil, gas and water wells, pipelines, etc.), and topography. Major factors in selecting the alternative sites were:

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

2. Distance from grounded metallic infrastructure that might be negatively impacted by DC ground currents. In general, this consideration results in the electrode site being a few miles or more from power plants, electrical substations, underground pipelines, and active oil or gas wells. The ground electrodes cannot be located within 2 miles of major pipelines due to the risk of having a corrosive impact on nearby metallic structures. Ground electrodes located within 2 – 10 miles of major pipelines may require additional or modified corrosion protection systems.

3. Land use constraints such as protected areas (National Parks, wilderness, etc.) and sensitive resource areas (e.g., sage-grouse leks and core areas). Secondary consideration is given to topography as it would be impractical to drill the ground wells in mountainous topography.

More detailed information will be required to make a final determination of the proposed ground electrode sites including: a) availability of public lands or private lands; b) detailed measurements of ground resistivity; c) chemical and thermal characteristics of the soil at the site; and d) a detailed analysis of grounded metallic infrastructures in the area. The location and layout of the selected ground electrode facility will also take into consideration existing and planned land uses, environmental constraints, routing of the ±600 kV DC transmission line, and the length and routing of the low voltage connector lines.

4.2.3.1 Northern Ground Electrode Alternative Sites

The ‘Separation Flat’ siting area contains the proposed northern ground electrode site. This proposed siting area would accommodate all routes into the Northern Terminal. The five alternative sites shown on Map Exhibit 5 would also connect to the Northern Terminal: Eight Mile Basin, Separation Creek, Shell Creek, Little Snake East, and Little Snake West.

4.2.3.2 Southern Ground Electrode Alternative Sites

The ‘Mormon Mesa-Carp Elgin Road’ siting area contains the proposed southern ground electrode site that would provide connection to the Southern Terminal. The two alternative sites shown on Map Exhibit 6 would also connect to the Southern Terminal: Halfway Wash E and Halfway Wash-Virgin River.

4.3 System Alternatives

TransWest amended the Preliminary ROW Application SF 299 to eliminate System Alternative 1 from further consideration in August 2012. Only two system alternatives remain, System Alternative 2 and System Alternative 3. Section 4.3 addresses two system alternatives considered for the TWE Project during the public scoping process as follows:

- Section 4.3.1 provides an overview of System Alternatives 2 and 3.

- Section 4.3.2 describes the system alternatives according to the conditions under which each system alternative would meet the TWE Project purpose and need and the alternative's specific components and design characteristics.

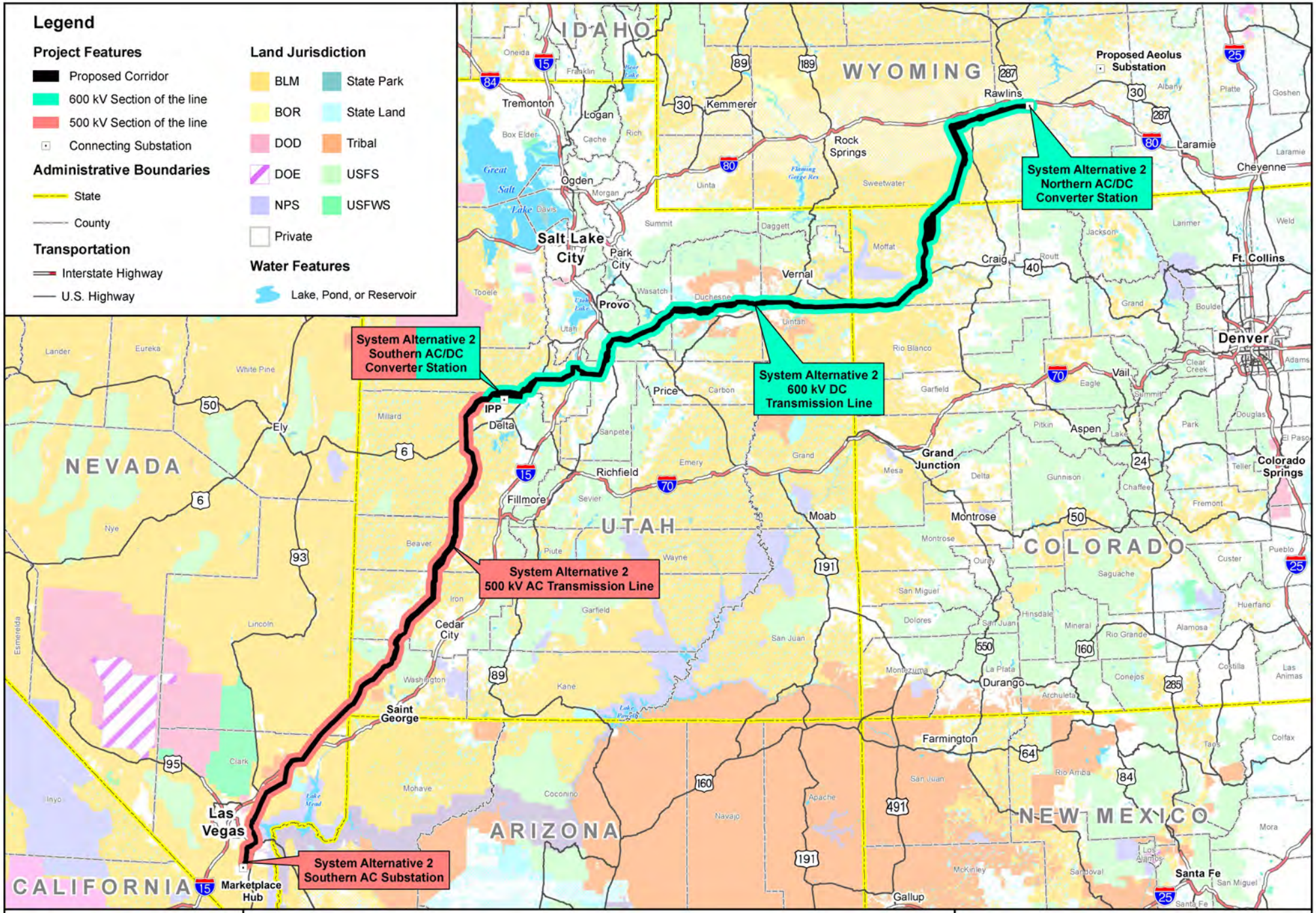
- Section 4.3.3 discusses how the system alternatives would differ from the proposed TWE Project with respect to construction, operation, and maintenance practices.

- Section 4.3.4 provides a comparison of the system alternatives to the proposed TWE Project.

4.3.1 Overview of Alternative Systems

System Alternative 2 - System Alternative 2 would be an alternative system configuration, which would replace the proposed TWE Project (Map Exhibit 7). This alternative would entail TransWest constructing and operating a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length, from the Northern Terminal to a new AC/DC converter station near the existing IPP Substation near Delta, Utah. From the new AC/DC converter station in Utah, a single circuit 1,500 MW, 500 kV AC transmission line, approximately 350 miles in length, would be constructed to one of the existing substations in the Eldorado Valley, south of Boulder City, Nevada (Marketplace Hub).

System Alternative 3 - System Alternative 3 would be a phased approach to building and operating the proposed TWE Project (Map Exhibit 8). This phased approach would entail construction of a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length between the location of the proposed Northern Terminal to the IPP substation near Delta, Utah and operated initially as a 1,500 MW, 500 kV AC transmission system. For AC operation, the initial phase of this system alternative would require 500/345 kV substation connections near the IPP line in Millard County, Utah and construction of a 500 kV Series Compensation Station near the halfway point of the northern segment. Full development of the TWE Project using this phased build out approach would involve constructing the remaining portion of the 3,000 MW, ±600 kV DC line from IPP to the Southern Terminal, south of Boulder City, Nevada and converting operations to a DC system.



Map Exhibit 7

System Alternative 2: DC from Wyoming to IPP, AC from IPP to Marketplace Hub

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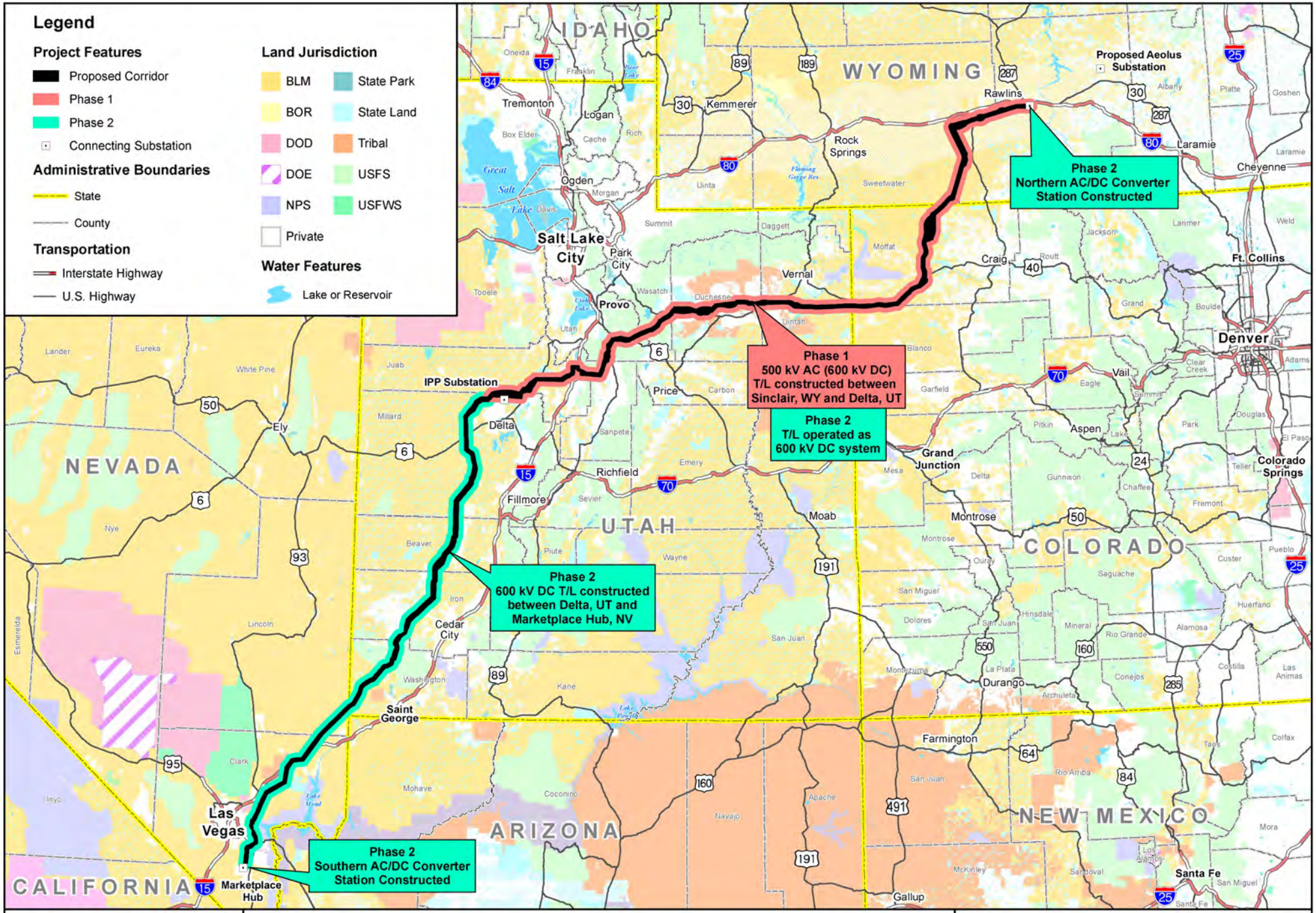

Map Exhibit 8
System Alternative 3: Phased Build-Out
TransWest Express Transmission Project | October 2012 | DRAFT

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4.3.2 Alternative Systems' Purpose and Need and Design Characteristics

4.3.2.1 System Alternative 2 – DC from Wyoming to IPP, AC from IPP to Marketplace Hub

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

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

System Alternative 2 would entail the following specific facilities and actions:

a. Construction of the Northern Terminal and ground electrode system (identical facilities to the proposed TWE Project);
b. Construction of a new AC/DC converter station and an adjacent 500/345 kV AC substation near the IPP in Millard County, Utah;
c. Construction of a ground electrode system within 50 miles of Delta, Utah;
d. Construction of a double circuit 345 kV AC line between the new 500/345 kV AC Substation near IPP to the existing IPP 345 kV AC substation adjacent to the existing IPP AC/DC converter station. The length of the double circuit 345 kV AC connection is estimated to be less than five miles;
e. Construction of a ±600 kV DC transmission line, approximately 375 miles long, from the Northern Terminal to the new AC/DC converter station and associated 500/345 kV substation near IPP (northern segment, similar to proposed TWE Project);
f. Construction of a single circuit, 1,500 MW, 500 kV AC line from the new 500/345 kV AC substation near IPP to one of the existing Marketplace Hub substations in the Eldorado Valley (southern segment); and
g. Construction of a series compensation station (similar to a small 500 kV substation) adjacent to the 500 kV AC transmission line, near the halfway point in the 500 kV AC line southern segment.

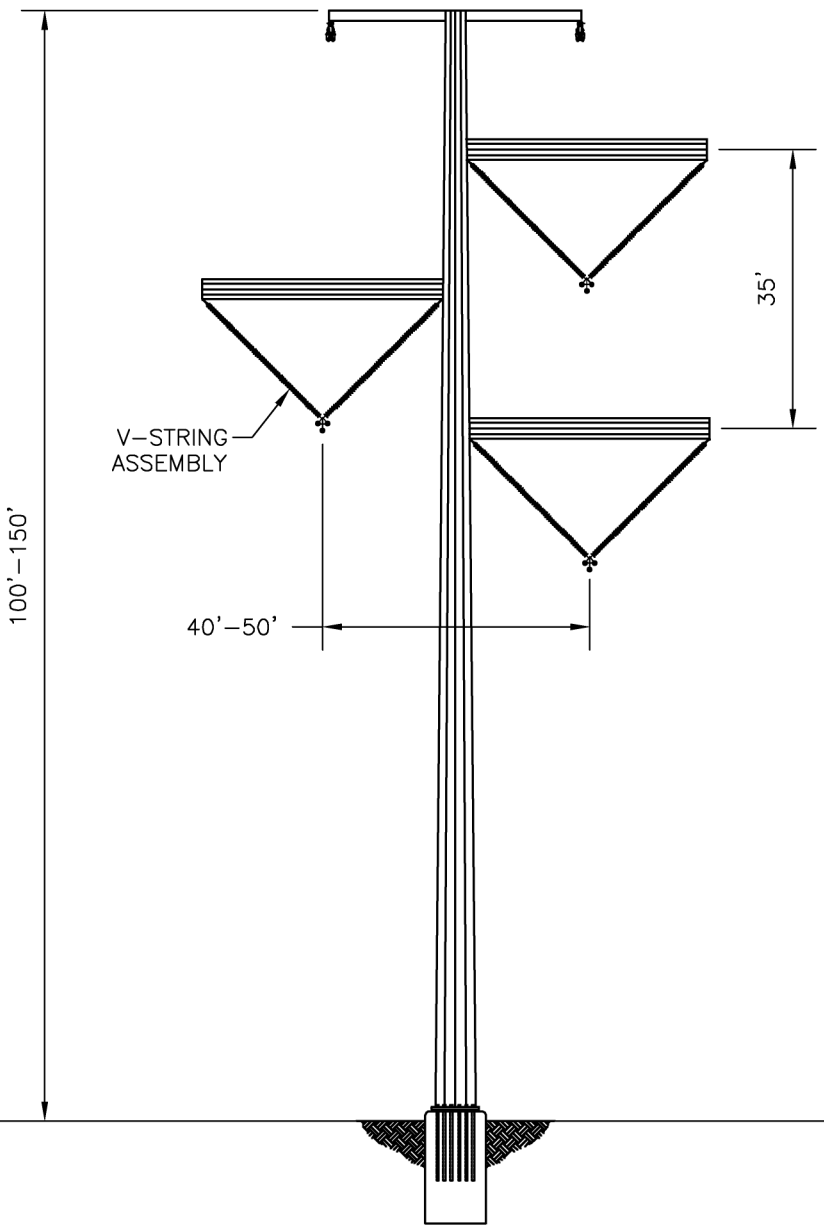
Compared to the proposed TWE Project, System Alternative 2 would: 1) replace the ±600 kV DC transmission line with a single circuit 500 kV AC line, from near IPP in Millard County, Utah to one of the existing Marketplace Hub substations in Clark County, Nevada[12]; 2) eliminate the Southern Terminal and ground electrode system in Clark County, Nevada and replace these facilities with similar facilities near IPP in Millard County, Utah; 3) construct additional new facilities, including a 500/345 kV AC substation, a double circuit 345 kV transmission line, less than five miles in length, and a 500 kV series compensation station, near the halfway point in the 500 kV AC line.

System Alternative 2 would require both a 500 kV single circuit AC configuration and a 345 kV double circuit AC configuration. System Alternative 2 would require a single circuit 500 kV configuration and structures, similar to the structure design shown in Figure 29. The 500 kV single circuit configuration would require three sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 500 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

One double circuit 345 kV transmission line would be required for System Alternatives 2 and 3. The 345 kV double circuit structures would be either self supporting steel lattice towers or single shaft tubular steel poles. Figure 30 shows a typical steel pole design. The 345 kV double circuit configuration would require six sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 345 kV structures including foundations, conductors, insulators, and associated hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

Map Exhibit 9 depicts the siting areas for the System Alternative 2 AC/DC converter station, 500/345 kV AC substation, ground electrode system, double circuit 345 kV connector line and the 500 kV series compensation station.

[12] Level 1 and Level 2 of the co-location distances framework applies to the 1,500 MW, 500 kV AC transmission portion of System Alternative 2. The selective use of Level 2 co-location distances can be used between the 1,500 MW, 500 kV AC transmission line segment and transmission lines with a voltage level of 500 kV and lower.



NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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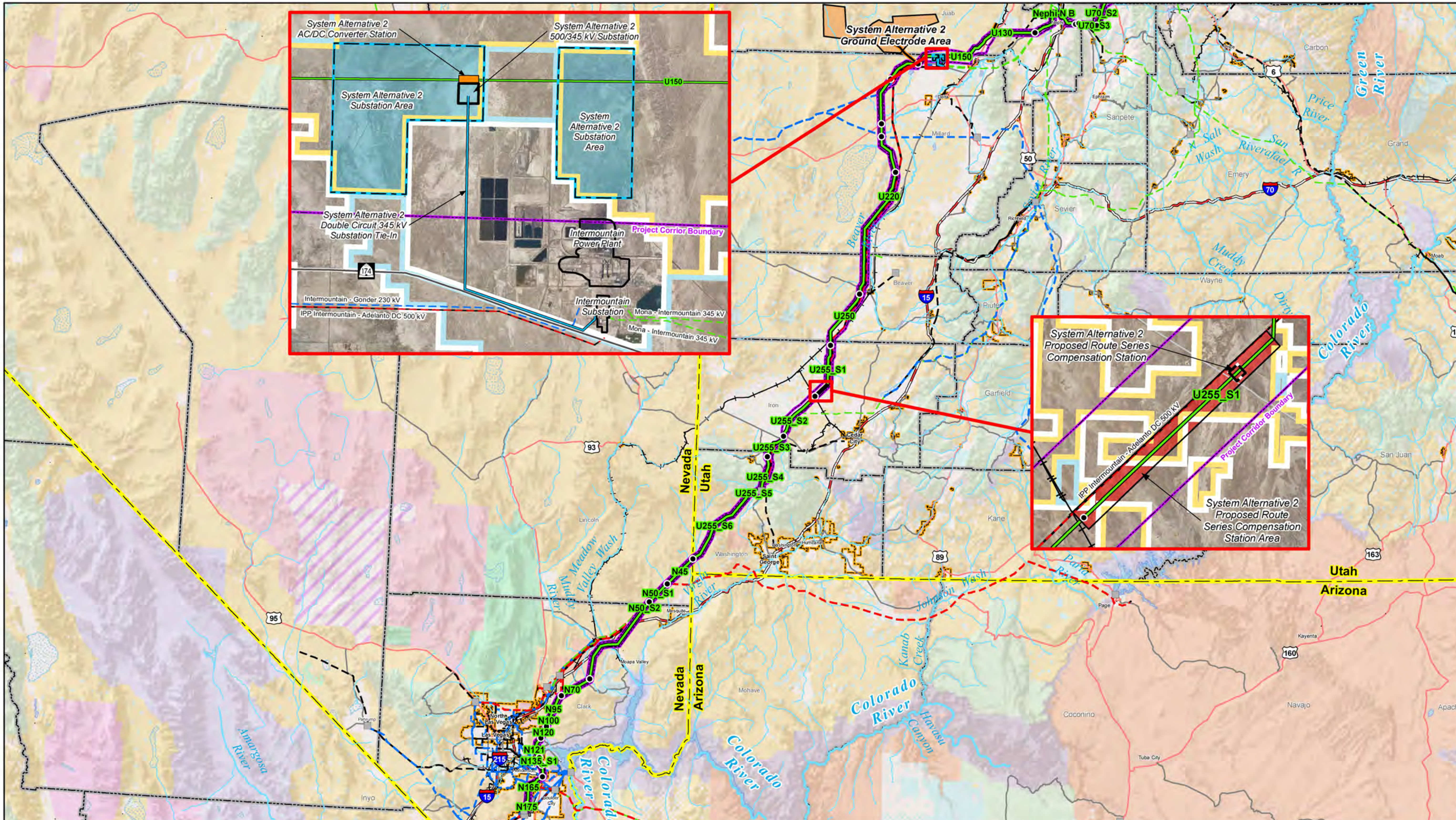
FIGURE 29

TYPICAL 500kV AC SINGLE CIRCUIT
TUBULAR POLE STRUCTURE



TransWest Express Transmission Project
October 2012 Draft

Map Exhibit 9

System Alternative 2 Components

Project Features
- Proposed Reference Line
- Route Segment Node
- Route Corridor
- Terminal Siting Area
- Ground Electrode Area
- Ground Electrode Site
- 34.5 kV Electrode Line

Administrative Boundaries
- Municipal Boundary

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

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

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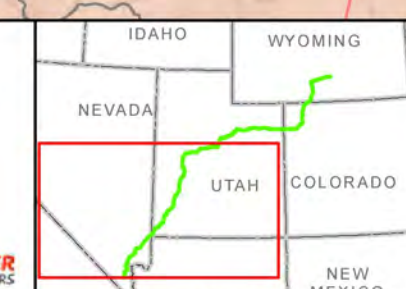

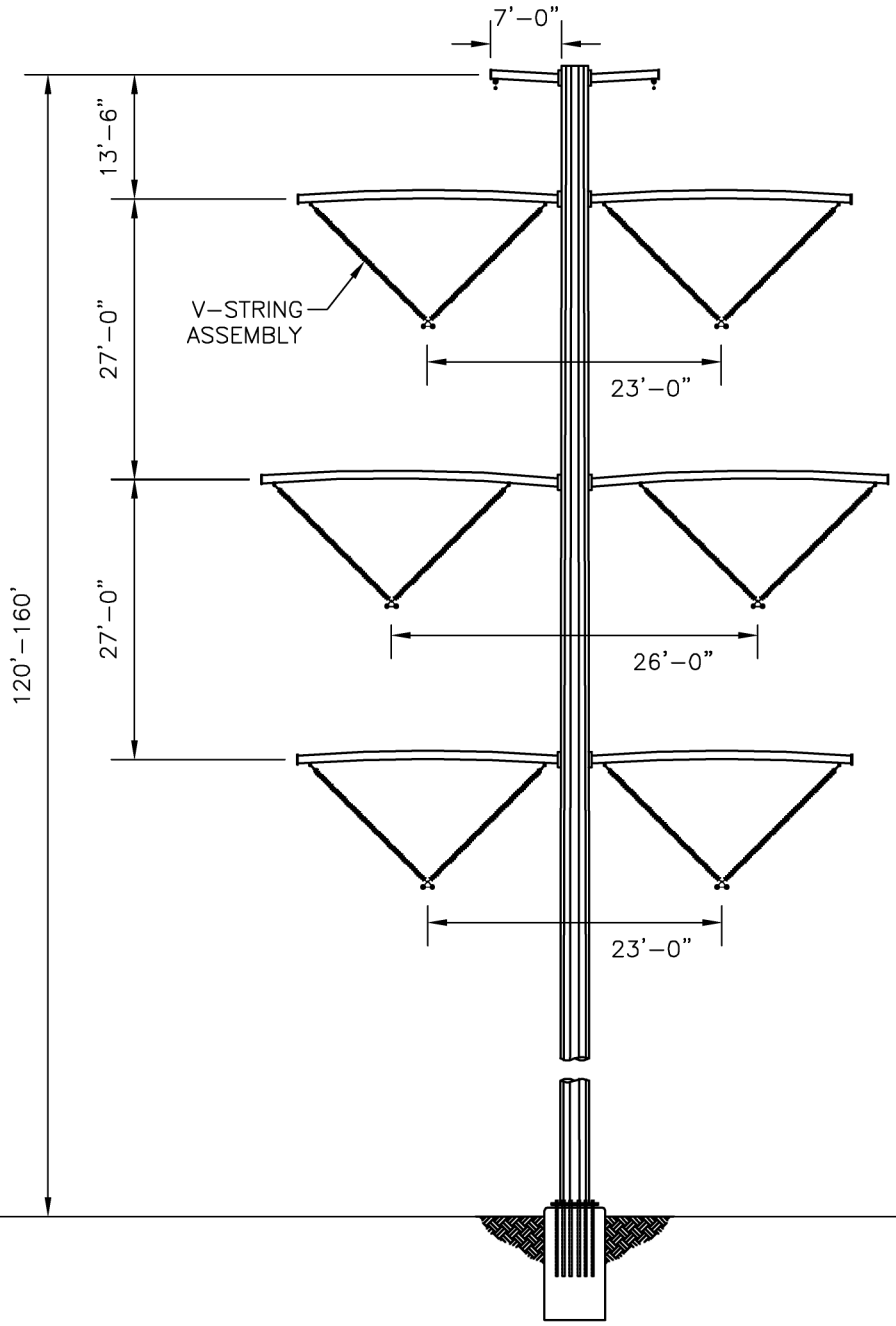

NOTES

1. DIMENSIONS SHOWN ARE FOR ILLUSTRATION PURPOSES ONLY.

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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 30

TYPICAL 345kV AC DOUBLE CIRCUIT
SELF SUPPORTING STEEL POLE STRUCTURE

4.3.2.3 System Alternative 3 – Phased Build Out

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

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

System Alternative 3 is similar to the proposed TWE Project, except the project would be built and operated in phases. This phased approach would entail construction of a 3,000 MW, ±600 kV DC transmission line approximately 375 miles in length between the location of the proposed Northern Terminal to the IPP substation near Delta, Utah and operated initially as a 1,500 MW, 500 kV AC transmission system. For AC operation, the initial phase of this system alternative would require 500/345 kV substation connections near the IPP in Millard County, Utah and construction of a 500 kV Series Compensation Station near the halfway point of the northern segment. Full development of the TWE Project using this phased build out approach would involve constructing the remaining portion of the 3,000 MW, ±600 kV DC line from IPP to the Southern Terminal, south of Boulder City, Nevada and converting operations to a DC system (see Map Exhibit 8).

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

a. Construction of the 500 kV substation portion of the Northern Terminal. The adjacent AC/DC converter station in Wyoming would be built in Phase 2;
b. Construction of a 500/345 kV AC substation in the vicinity of the existing IPP 345 kV substation near Delta, Utah;
c. Construction of a single circuit 500 kV AC line from the Northern Terminal near Sinclair, Wyoming to the new 500/345 kV AC substation near IPP (northern line segment). The single circuit 500 kV AC line would be designed to operate at both 500 kV AC and ±600 kV DC for easy conversion to ±600 kV DC operation;
d. Construction of a 500 kV series compensation station near the halfway point of the 500 kV AC northern line segment;
e. Construction of a double circuit 345 kV transmission line connecting the new 500/345 kV AC substation to the existing IPP 345 kV substation. The length of the double circuit 345 kV AC connection is estimated to be less than five miles; and

f. Energization of Phase 1 of System Alternative 3 as a 1,500 MW, 500 kV AC system.

Phase 2 would entail the following:

a. Construction of the AC/DC converter station portion of the Northern Terminal in Wyoming and construction of the entire Southern Terminal in Nevada;
b. Construction of the ground electrodes for both the Northern and Southern Terminals (see Map Exhibits 5 and 6);
c. Construction of the ±600 kV DC transmission line between IPP and the Southern Terminal (southern line segment);
d. Removal of the connection to the IPP substation at Delta, Utah and connecting the Phase 1 500 kV AC line (constructed during Phase 1, designed for conversion to ±600 kV DC and operated at 500 kV AC during Phase 1) to the Phase 2 ±600 kV DC line between Delta, Utah and the Southern Terminal;
e. Convert the operation of the TWE Project to a 3,000 MW, ±600 kV DC system;
f. Decommission the 500/345 kV AC substation at IPP;
g. Decommission the double circuit 345 kV transmission line at IPP; and
h. Decommission the series compensation station on the 500 kV AC northern line segment.

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

Phase 1 of System Alternative 3 would require a single circuit 500 kV AC configuration designed and constructed to meet the ±600 kV DC criteria. The typical Phase 1 single circuit 500 kV AC structures would be similar in appearance to those shown in Figure 29. The single circuit 500 kV AC configuration would require three sets of conductor bundles, one steel shield wire, and one OPGW. The conversion from 500 kV AC to ±600 kV DC would not require physical changes to the structure or wire system constructed in Phase 1 as one of the three conductor bundle sets would be de-energized and left in place.

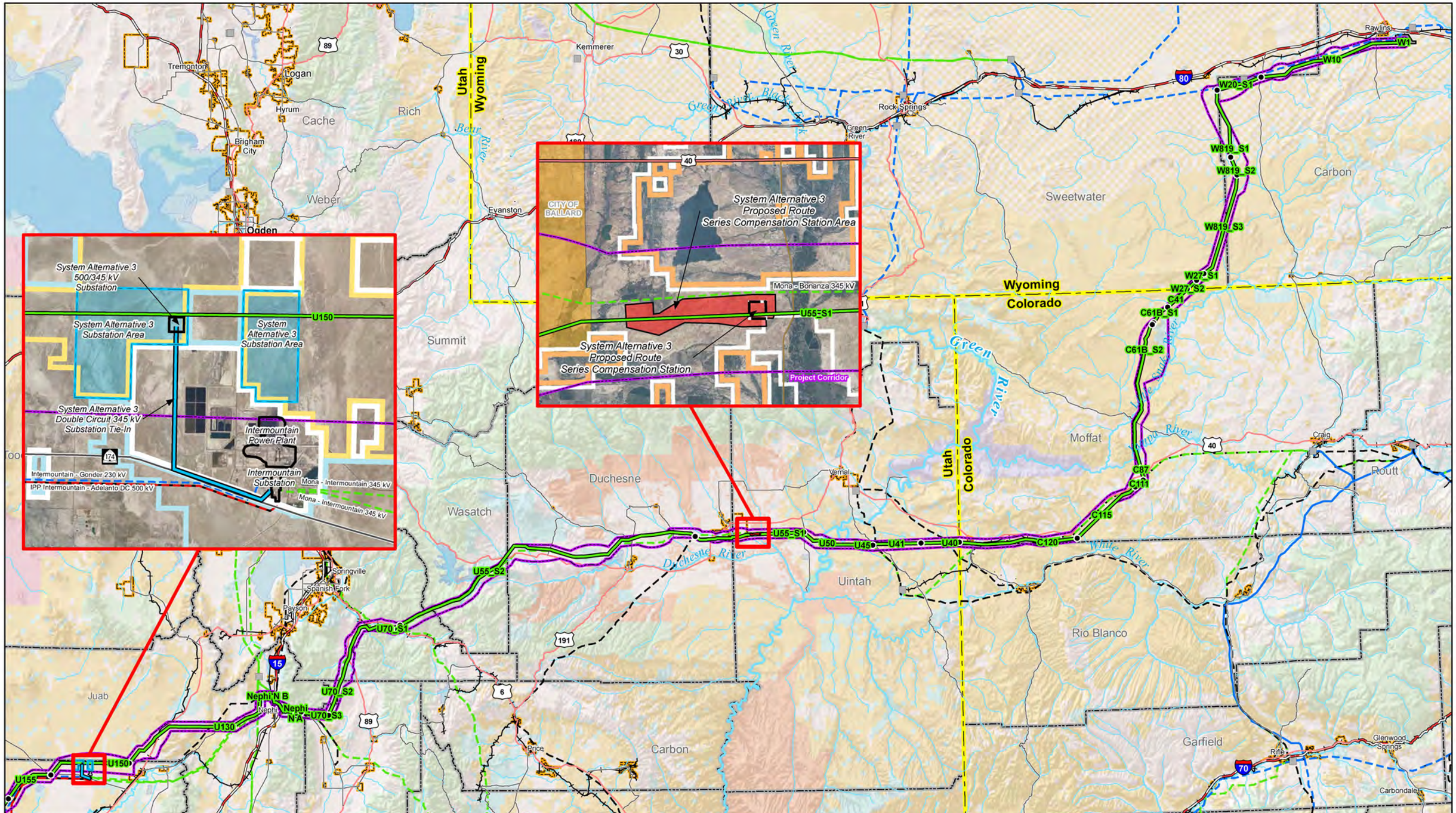
Phase 1 of System Alternative 3 would also require one 345 kV double circuit transmission line. The 345 kV double circuit structures would be either self supporting steel lattice towers or single shaft tubular steel poles. Figure 30 shows a typical steel pole design. The 345 kV double circuit configuration would require six sets of conductor bundles, one steel shield wire, and one OPGW. The components for the 345 kV structures including foundations, conductors, insulators, and associated

hardware, overhead shield (ground) wires, and grounding rods, would be similar to those described for the ±600 kV DC transmission line.

Map Exhibit 10 depicts the siting areas for the System Alternative 3 components, including the 500/345 kV AC substation, double circuit 345 kV connector lines and the 500 kV series compensation station.

4.3.3 Construction, Operation and Maintenance Activities of System Alternatives

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



TransWest Express Transmission Project
October 2012 Draft

Map Exhibit 10

System Alternative 3 Components

Project Features
- Proposed Reference Line
- Route Segment Node
- Route Corridor
- Terminal Siting Area

Administrative Boundaries
- Municipal Boundary

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

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

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4.3.3.1 System Alternative Construction Activities, Workforce and Equipment Requirements

The construction activities, workforce and equipment requirements for the transmission line and terminals would be very similar or the same for the system alternatives as described for the proposed TWE Project in Section 3.5.9. Construction of each substation or series compensation station would require approximately 135 personnel. The construction activities, workforce and equipment requirements for the substations and series compensation stations for System Alternatives 2 and 3 would be approximately as shown in Table 10. Special construction methods and Applicant-committed mitigation measures would apply to these alternatives, as presented in Sections 3.5.7 and 3.7.

TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR SYSTEM ALTERNATIVE SUBSTATIONS

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

TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR SYSTEM ALTERNATIVE SUBSTATIONS			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Crew		2	Boom trucks
		1	Excavator
		3	Concrete trucks
		1	Dump truck
		1	Roller compactor
		2	Plate compactors
		1	Backhoe
		2	Bobcats
		1	Mechanics truck
		1	Fuel truck
		1	Water truck
		2	Pickup trucks
		4	Carry alls
Cable Trench, Conduits, and Station Grounding Crew	10-12	2	Trenchers
		2	Dozers (ripper)
		2	Roller compactors
		2	Plate compactors
		2	Excavators
		1	Boom truck
		3	Pickup trucks
		2	Flatbed trucks
		4	Carry alls
		1	Air compressor
		1	Backhoe
		1	Mechanics truck
		1	Fuel truck
		1	Dump truck
		1	Reel stand truck
Steel Structure and Bus Installation Crew, Control Buildings Construction Crew, Equipment Assembly and	16-24	2	Cranes, RT
		2	High capacity cranes
		4	Boom trucks

TABLE 10 ESTIMATED PERSONNEL AND EQUIPMENT FOR SYSTEM ALTERNATIVE SUBSTATIONS			
ACTIVITY	PEOPLE	QUANTITY AND TYPE OF EQUIPMENT	
Erection Crew		6	Manlifts
		4	Welder trucks
		2	Carry alls
		3	Pickup trucks
		2	Flatbed trucks
		1	Mechanics truck
		4	Vans
		2	Flatbed trucks
Control Building and Wiring Crew	16-20	2	Boom trucks
		4	Manlifts
		3	Wire pullers-small
		2	Reel stand trucks/trailers
		4	Vans
		4	Pickup trucks
		2	Carry alls
		1	Splicing van
		2	Concrete trucks
		1	Bobcat
		1	Trencher
		2	Plate compactors

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

4.3.3.2 System Alternative Construction Schedules

The conceptual construction schedule for the transmission line for System Alternative 2 would employ a three spread approach very similar to the schedule presented for the proposed TWE Project in Section 3.5.9.1 and shown on Figure 18. For System Alternative 2, the conceptual construction schedules shown in Figure 18 would need to be increased by approximately ten weeks to accommodate the additional work required for installing an AC transmission line in place of a DC transmission line.

The conceptual construction schedule for the transmission lines for System Alternative 3 follows a phased approach and is shown on Figure 33. The conceptual construction schedule shown on Figure 33 would be used for both Phase 1 and Phase 2 of System Alternative 3.

The construction schedules for the terminal, ground electrodes, substations and series compensation stations for System Alternatives 2 and 3 would differ from the proposed TWE Project, as illustrated on Figures 31 and 32.

4.3.3.3 Induced Currents on AC Transmission Systems

Unlike the proposed TWE Project ±600 kV DC transmission line, which presents no risk of inducing currents line due to the static nature of the DC electrical and magnetic fields, AC transmission systems can induce currents. Mitigation measures for AC inductive currents would be implemented as necessary for the AC portions of System Alternatives 2 and 3.[13] Mitigation measures would be incorporated into the siting of the AC transmission line ROWs, as well as through transmission line design and operation measures. Measures to mitigate induced current impacts on pipelines, railroads and other land uses are described in Appendix D.

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

SYSTEM ALTERNATIVE - 2

TOTAL DURATION: 111 week

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

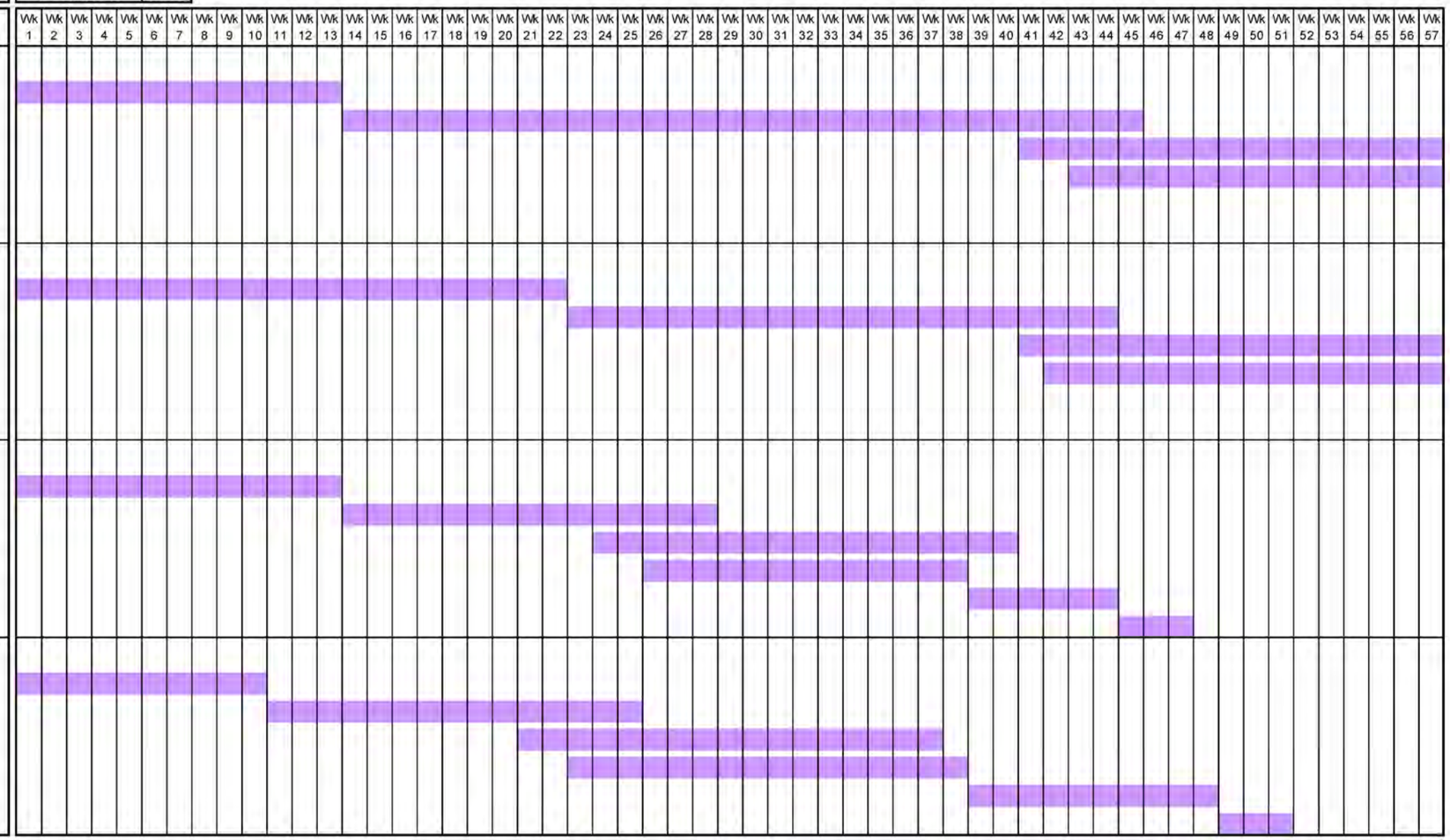

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FIGURE 31
CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 2 TERMINALS, SUBSTATIONS AND SERIES COMPENSATION STATION – SHEET 1

SYSTEM ALTERNATIVE - 2

TOTAL DURATION **111 week**

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

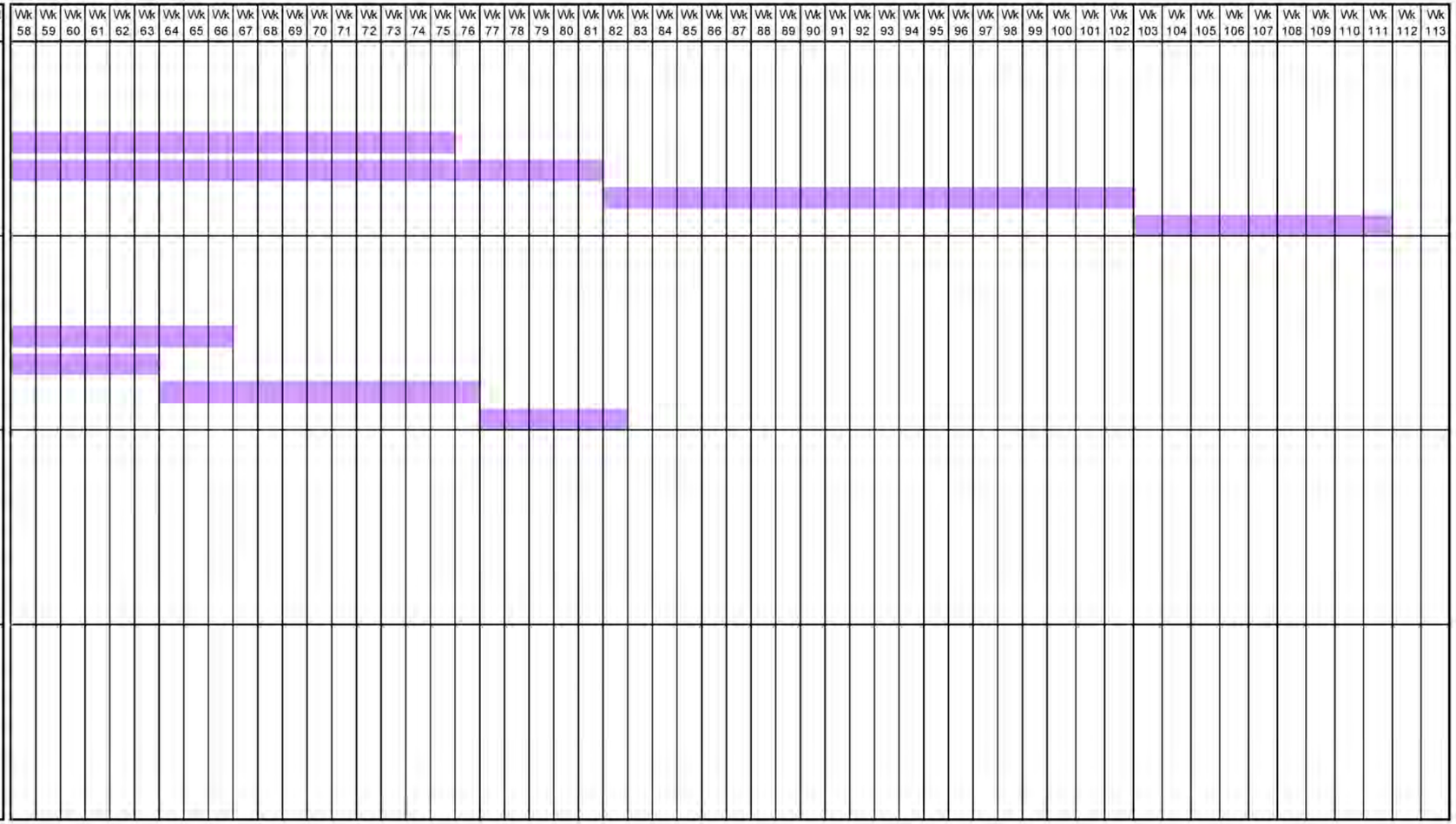

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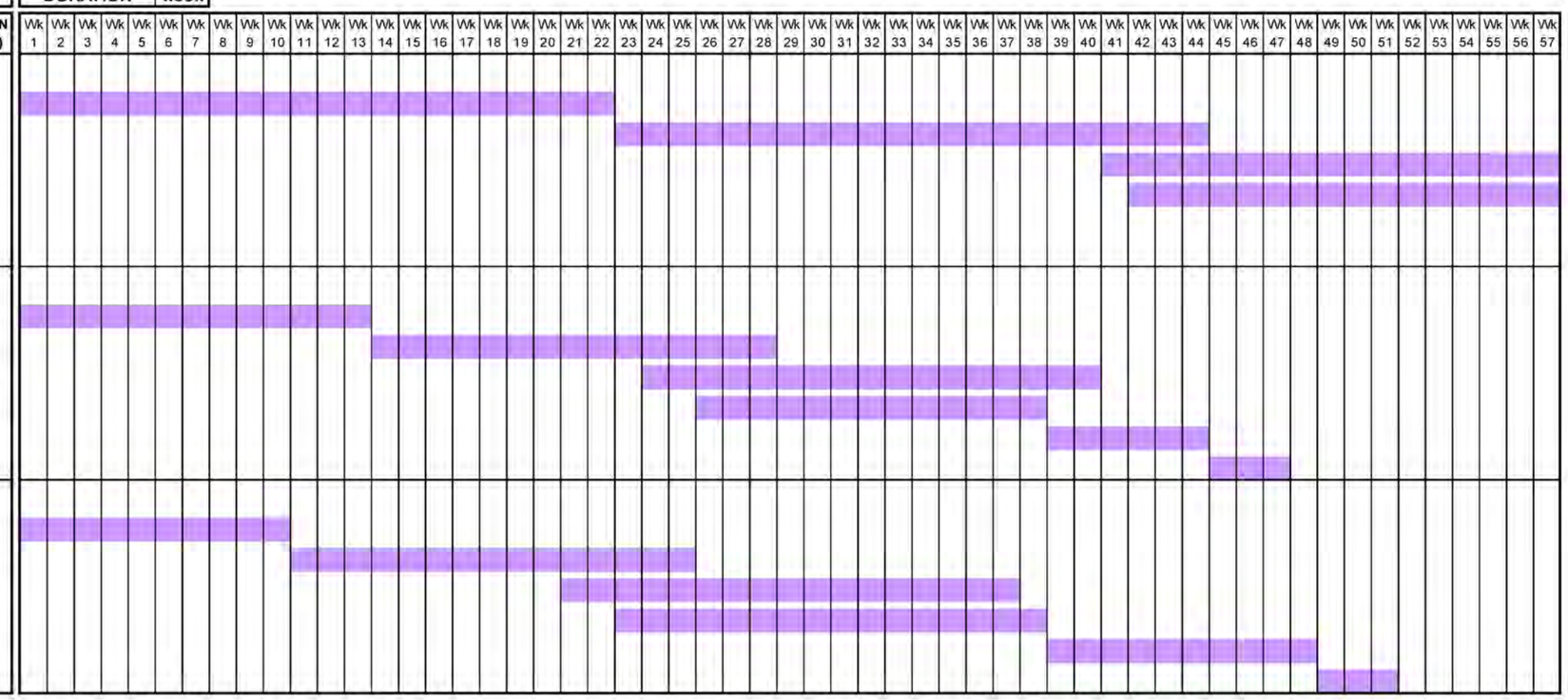
FIGURE 31
CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 2 TERMINALS, SUBSTATIONS AND SERIES COMPENSATION STATION – SHEET 2

SYSTEM ALTERNATIVE - 3

TOTAL DURATION **82 week**

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



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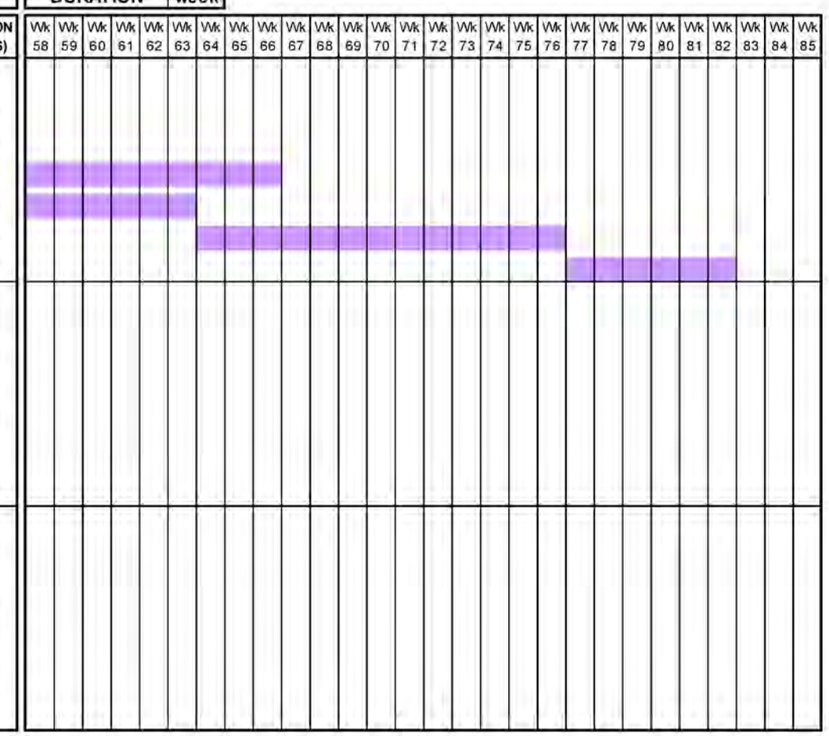
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 32

CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 3 SUBSTATION AND SERIES COMPENSATION STATION – SHEET 1

SYSTEM ALTERNATIVE - 3

TOTAL DURATION 82 week

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



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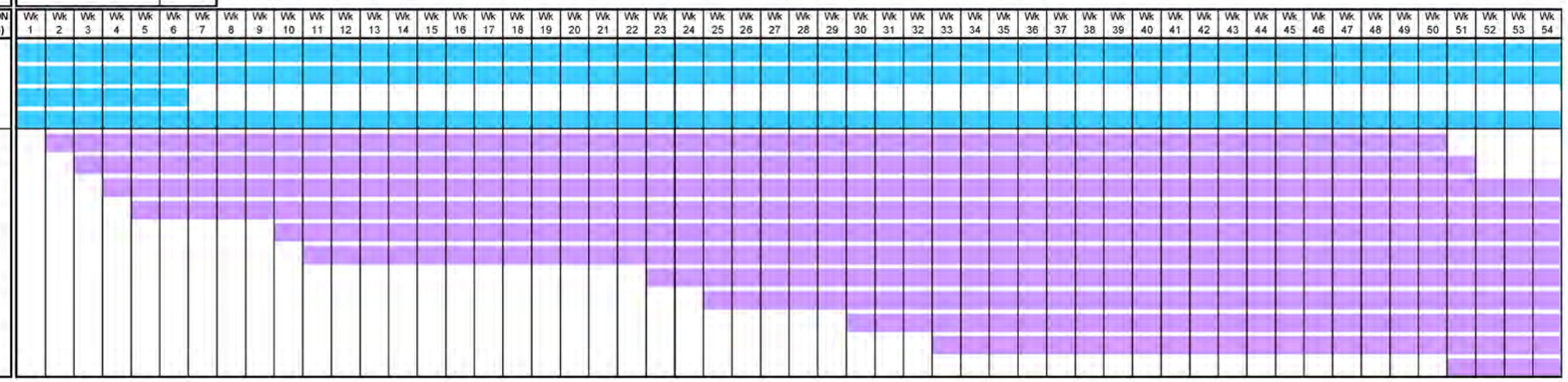
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 32

CONSTRUCTION SCHEDULE FOR SYSTEM ALTERNATIVE 3 SUBSTATION AND SERIES COMPENSATION STATION – SHEET 2

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION: 122 weeks

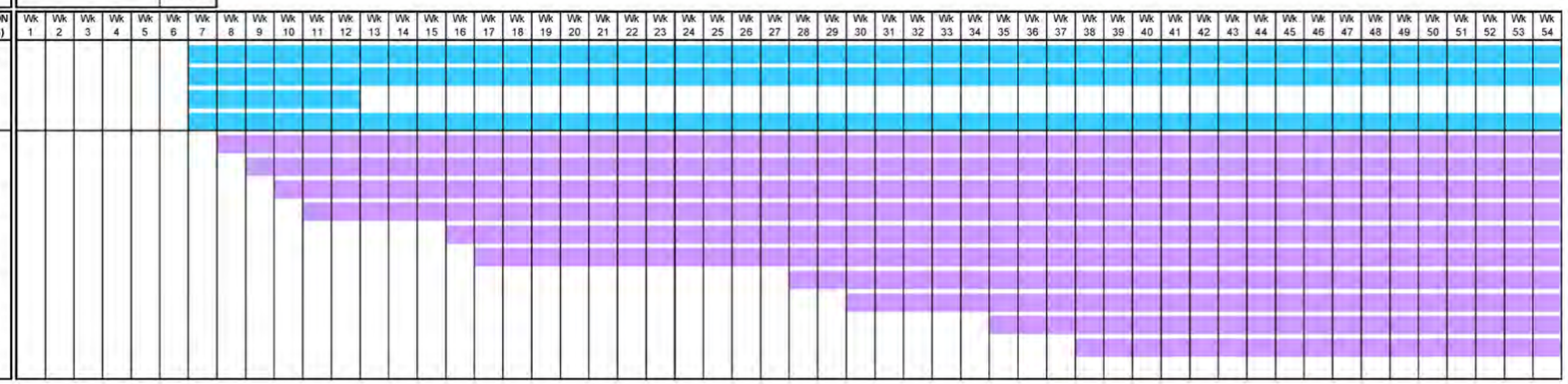
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE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



SECTION 2 - APPROXIMATELY 182 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U150)

TOTAL DURATION: 124 weeks

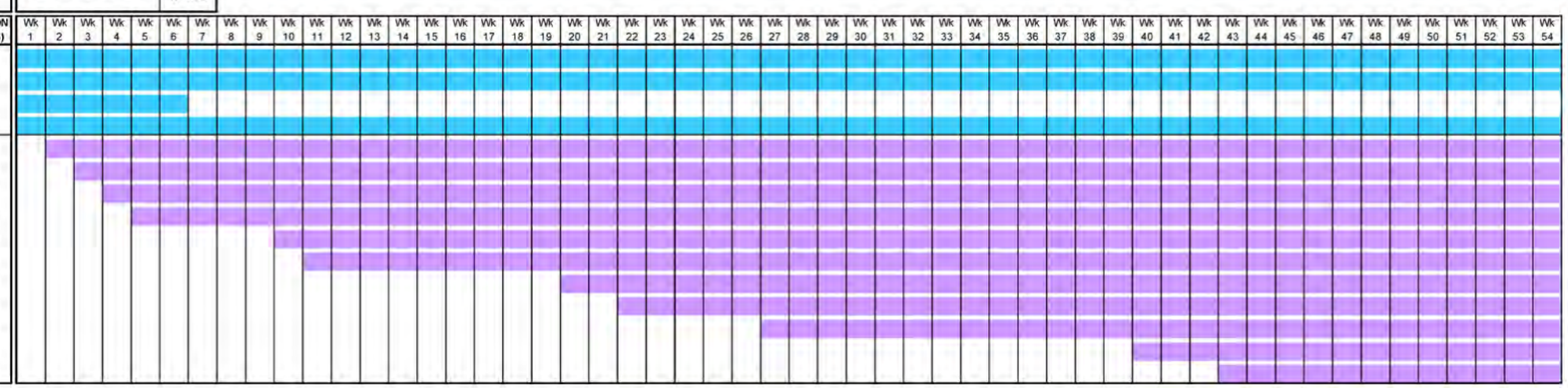
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE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



SECTION 3 - APPROXIMATELY 322 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U155 - SOUTHERN TERMINAL)

TOTAL DURATION: 140 weeks

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



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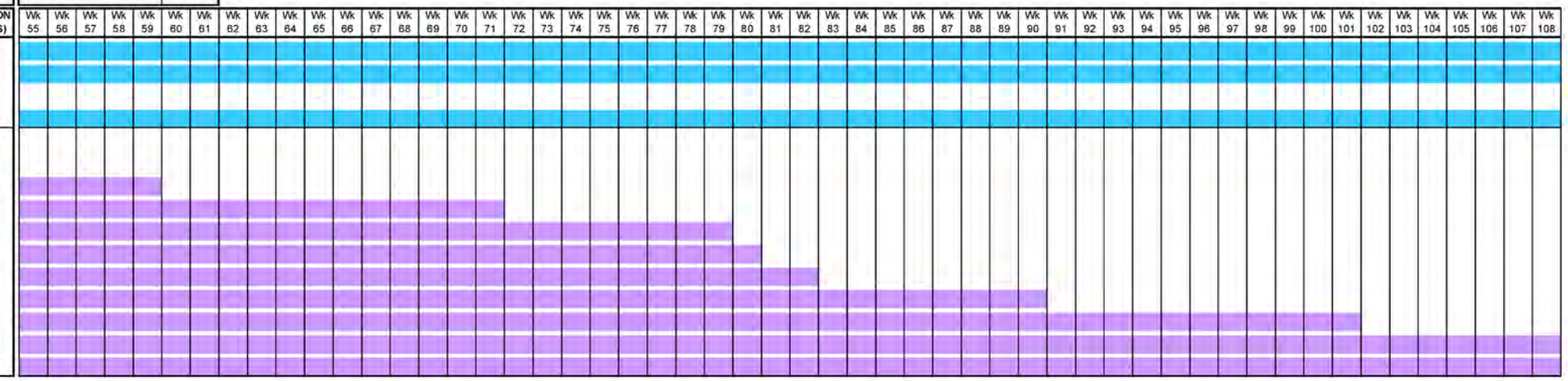
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 33

CONSTRUCTION SCHEDULE FOR
SYSTEM ALTERNATIVE 3 TRANSMISSION LINE
SHEET 1

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION: 111 weeks

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



SECTION 2 - APPROXIMATELY 182 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U150)

TOTAL DURATION: 124 weeks

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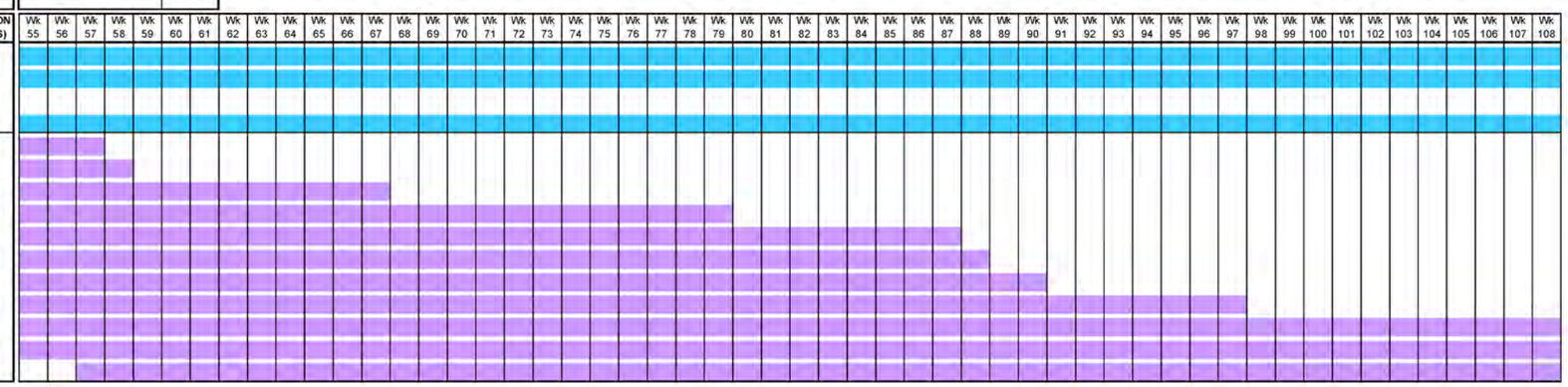
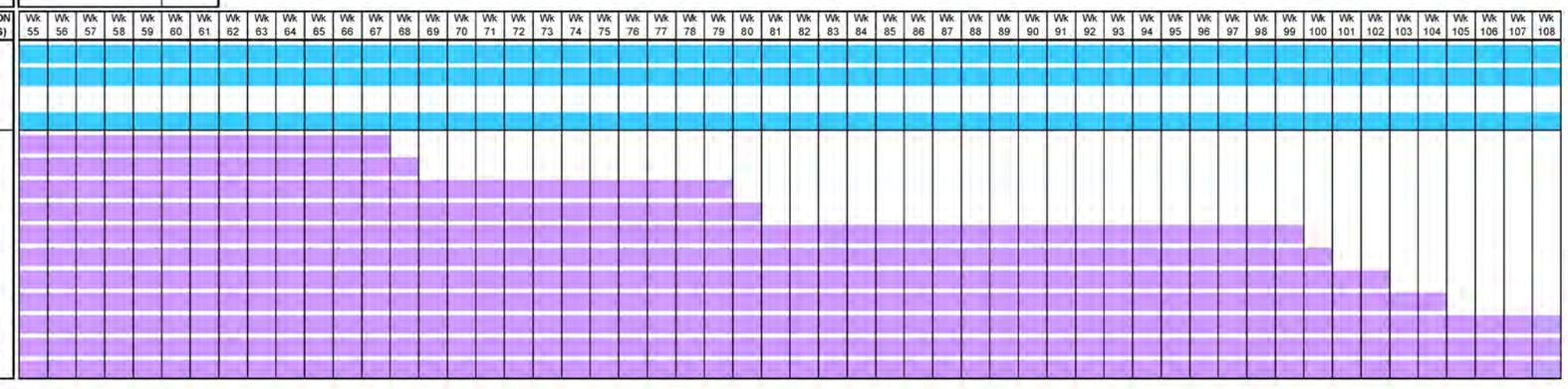
ERECT SELF SUPPORTING LATTICE STRUCTURE	74
WIRE INSTALLATION	88
FINAL CLEAN UP / RECLAMATION / RESTORATION	72



SECTION 3 - APPROXIMATELY 322 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U155 - SOUTHERN TERMINAL)

TOTAL DURATION: 140 weeks

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



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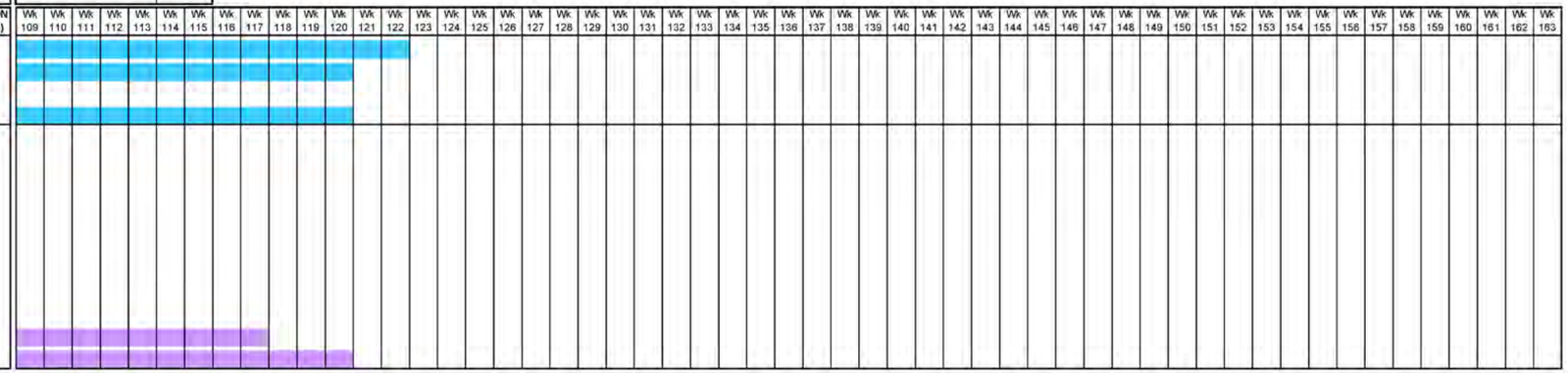
TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 33

CONSTRUCTION SCHEDULE FOR
SYSTEM ALTERNATIVE 3 TRANSMISSION LINE
SHEET 2

SECTION 1 - APPROXIMATELY 221 MILES
NORTHERN TERMINAL - NORTHEASTERN UTAH
(NORTHERN TERMINAL - ROUTE SEGMENT U50)

TOTAL DURATION: 122 weeks

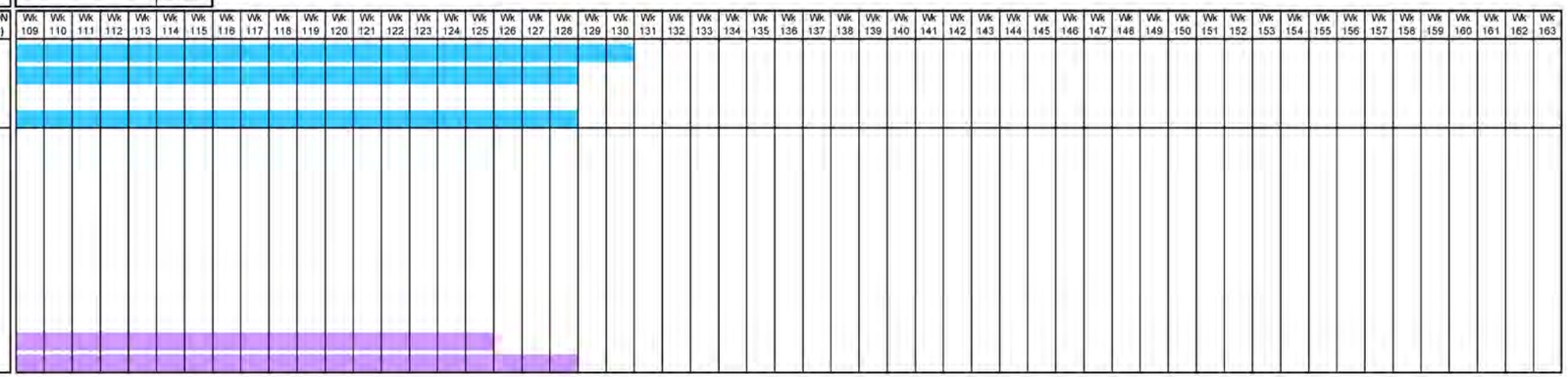
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	122
INSPECTION	120
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	120
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	49
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	49
GEOLOGICAL INVESTIGATIONS	56
SURVEY / STAKE STRUCTURE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



SECTION 2 - APPROXIMATELY 182 MILES
NORTHEASTERN UTAH - WEST CENTRAL UTAH
(ROUTE SEGMENT U55 - ROUTE SEGMENT U150)

TOTAL DURATION: 124 weeks

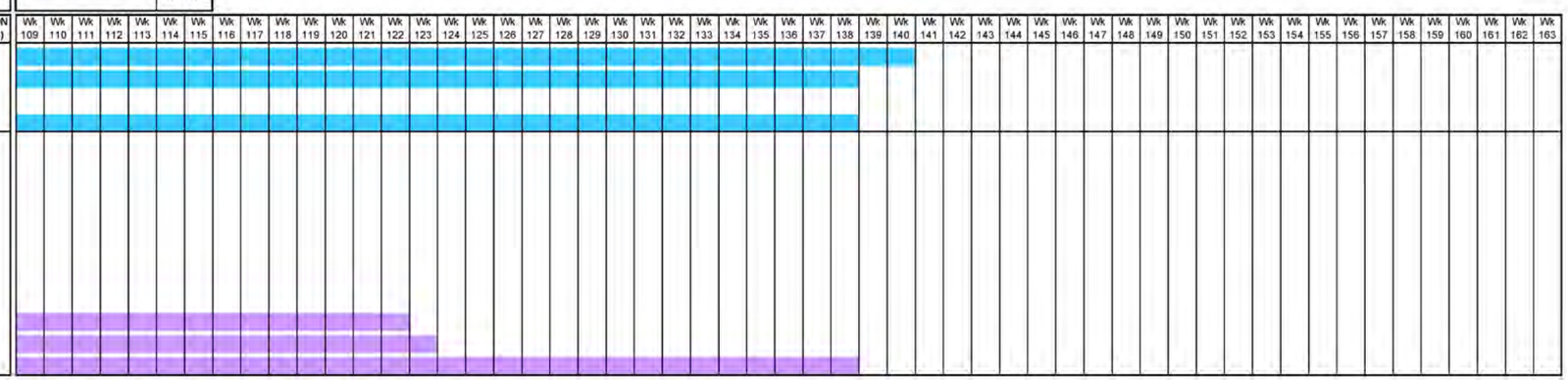
TASK	DURATION (WEEKS)
CONSTRUCTION MANAGEMENT / ENGINEERING SUPPORT / ADMINISTRATION	124
INSPECTION	122
MOBILIZE CONTRACTOR	6
RECEIVE / HANDLE MATERIALS	122
SURVEY / STAKE ACCESS ROADS & STRUCTURE PADS	50
CONSTRUCT ACCESS ROADS AND / OR STRUCTURE PADS	50
GEOLOGICAL INVESTIGATIONS	58
SURVEY / STAKE STRUCTURE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



SECTION 3 - APPROXIMATELY 322 MILES
WEST CENTRAL UTAH - SOUTHERN TERMINAL
(ROUTE SEGMENT U155 - SOUTHERN TERMINAL)

TOTAL DURATION: 140 weeks

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



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TRANSWEST EXPRESS TRANSMISSION PROJECT
FIGURE 33

CONSTRUCTION SCHEDULE FOR
SYSTEM ALTERNATIVE 3 TRANSMISSION LINE
SHEET 3

4.3.4 Comparison of Proposed TWE Project to System Alternatives

Table 11 provides a comparison summary of System Alternatives 2 and 3 to the proposed TWE Project.

TABLE 11 COMPARISON OF PROPOSED TWE PROJECT TO SYSTEM ALTERNATIVES

COMPARISON FACTORS	PROPOSED TWE PROJECT	SYSTEM ALTERNATIVE 2	SYSTEM ALTERNATIVE 3
TWE Project Configuration	Two-terminal ±600 kV DC transmission line between WY and NV with potential interconnection to IPP system near Delta, UT.	Two terminal ±600 kV DC transmission line between WY and IPP system near Delta, UT. Two terminal single circuit 500 kV AC transmission line between Delta, UT and NV.	Phased Approach Phase 1 – Two terminal 500 kV AC (±600 kV DC) line between WY and IPP near Delta, UT. Phase 2 – proposed TWE Project. Involves building DC line from IPP to Marketplace and two AC/DC converter stations.
Contingencies for System Alternatives	N/A .	Capacity available in the future on IPP STS to serve Desert Southwest.	Capacity available in the future on IPP STS to serve Desert Southwest. The need for transmission capacity requires a phased implementation.
Current Status of System Contingencies and System Alternatives	N/A .	Future available capacity on the IPP STS is uncertain. Therefore, the status of System Alternative 2 is uncertain.	Future available capacity on the IPP STS is uncertain. Currently, all of the TWE Project's 3,000 MW of capacity is needed by the projected in-service date. It is unlikely System Alternative 3 will be pursued.

TABLE 11 COMPARISON OF PROPOSED TWE PROJECT TO SYSTEM ALTERNATIVES			
COMPARISON FACTORS	PROPOSED TWE PROJECT	SYSTEM ALTERNATIVE 2	SYSTEM ALTERNATIVE 3
Routing Alternatives	As part of the EIS preparation, the BLM and Western have established three regions for the TWE Project route. Each region has a distinct set of Route Alternatives.	The TWE Project route region and all Route Alternatives for each region all apply to System Alternative 2.	The TWE Project route region and all Route Alternatives for each region all apply to System Alternative 3.
System Capacity	3,000 MW between WY and NV	3,000 MW between WY and UT 1,500 MW between UT and NV	Phase 1 - 1,500 MW between WY and UT Phase 2 - 3,000 MW between WY and NV
Typical Transmission Line Towers Used	Guyed or self supporting lattice towers holding up two conductor bundles for entire Project.	Guyed or self supporting lattice towers holding up two conductor bundles between WY and Delta, UT. Guyed or self supporting lattice towers holding up three conductor bundles between Delta, UT and NV.	Guyed or self supporting lattice towers holding up three conductor bundles between WY and Delta, UT. Guyed or self supporting lattice towers holding up two conductor bundles between Delta, UT and NV.
Terminals - AC/DC Converter Stations	Northern Terminal near Sinclair, WY. Southern Terminal at Marketplace Hub near Boulder City, NV.	Northern Terminal same as proposed TWE Project. Southern Terminal near the IPP near Delta, UT.	Phase 1 – no AC/DC Converter Stations Phase 2 - Same as proposed TWE Project.

TABLE 11 COMPARISON OF PROPOSED TWE PROJECT TO SYSTEM ALTERNATIVES			
COMPARISON FACTORS	PROPOSED TWE PROJECT	SYSTEM ALTERNATIVE 2	SYSTEM ALTERNATIVE 3
TWE Project Interconnections	Northern Terminal will interconnect with existing 230 kV line and one (two total) 500 kV circuit of the Energy Gateway West and Energy Gateway South projects. Southern Terminal will interconnect with the existing 500 kV AC substations (up to 4 total) at the Marketplace Hub near Boulder City, NV. Potential interconnection with IPP system near Delta, UT.	Same as proposed TWE Project for Northern Terminal. Southern Terminal would be located near Delta, UT and would be interconnected to the IPP transmission system, and the TWE Project 500 kV AC line. The TWE Project 500 kV AC line would interconnect with one of the existing 500 kV AC substations at the Marketplace Hub near Boulder City, NV.	Phase 1 – The TWE Project 500 kV AC line would interconnect with the existing 230 kV line and the 500 kV Energy Gateway West and Energy Gateway South lines in WY and with the IPP Substation near Delta, UT. Phase 2 – same as the proposed TWE Project.
Related Structures and Facilities	Fiber optic network communications system. Two ground electrode facilities near terminals.	Same as the proposed TWE Project, however, ground electrode facility would be within 50 miles of the Southern Terminal near IPP Substation, Delta, UT.	Phase 1 – Fiber optic network communications system between WY and NV. No ground electrode. Phase 2 - Same as proposed TWE Project.

4.4 Underground Alternatives

Underground cable systems have been considered and evaluated for the TWE Project. To date, underground cable technology is not commercially available at the very high voltage and capacity levels (i.e., 600 kV and 3,000 MW) required to meet the TWE Project's purpose and need. The technology is not presently available, nor is it likely that it will become available within the time frame for the construction of the Project. The Applicant is committed to using the latest and most applicable commercially available technology. While there are theoretical and laboratory experiments in place that could conceivably be applied to the voltage and capacity levels of the TWE Project, there are no AC or DC underground installations worldwide above 500 kV or 2,000 MW either in-service or planned to be in-service in the next decade.

Advancements have been made in underground technology, however, sufficient testing or installation data for a ±600 kV, 3,000 MW underground application is not currently available. The Applicant will continue to consider and evaluate the technical and commercial feasibility of underground technologies for the TWE Project, however advancements in the technology to make undergrounding any portion of the Project feasible is not likely.

Below is a brief description of the various technologies, including information on the voltage levels that have been achieved for underground and submarine systems in service and advancements under development.

4.4.1 Underground Cable System Technologies

Self Contained Fluid Filled Cable - Self-contained fluid filled (SCFF) cable systems are typically constructed around a hollow tube, used for fluid circulation, and use Kraft paper insulation or a laminated polypropylene paper (LPP) insulation that is impregnated with dielectric fluid to minimize the insulation breakdown under electrical stress. To maintain pressure within the system, pumping plants are required every seven to ten miles along the route, assuming a relatively flat topography. The pumping plants are responsible for maintaining a constant pressure on the system, but must have large reserve tanks to facilitate the expansion and contraction of the dielectric fluid as the system undergoes thermal cycling.

While SCFF cable systems have the longest running history at the EHV levels, their use is typically restrained to long submarine cable installations. However, this technology has been implemented on inland applications with high reliability at voltages up to ±450 kV DC. Installations above this level do not exist worldwide.

Mass Impregnated – Mass impregnated (MI) cable systems account for nearly 80% of the worldwide long distance DC submarine installations. Constructed with ether Kraft paper or LPP insulation that is impregnated with a dielectric fluid, MI cables are similar to SCFF systems except fluid pumping facilities are not required. By reducing the number of system components, it can be argued that MI cable systems are more reliable than their SCFF counterparts and this conclusion if generally supported by a long running reliability track record. To date, ±500 kV DC is the highest voltage system in operation worldwide.

Cross Linked Polyethylene - Cross linked polyethylene (XLPE) cable systems are the most advanced solid dielectric cables found within the industry. Currently ±150 kV DC is the highest rated cable system in the world, however design and installation of a ±320 kV DC system is presently

underway. The use of HVDC solid dielectric cable has been delayed due primarily to complications with the XLPE insulation. The main concern with XLPE insulation is the buildup of space charges in the insulation and their subsequent distortion of the electrical stress distribution. Recent progress in the development of a modified XLPE insulation has apparently been successful in solving the space-charge problem, and the Japanese have prepared an International Council on Large Electric Systems paper documenting testing of a XLPE cable up to ±500 kV with satisfactory results.

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APPENDICES

APPENDIX A

TWE PROJECT COMPONENTS DISTURBANCE AND ACCESS ROAD METHODOLOGY

TWE Project Components Disturbance Methodology

The typical design characteristics of the TWE Project components shown in Table 1 were used to develop Excel spreadsheets that calculated the temporary and permanent land disturbance resulting from the TWE Project + 600 kV transmission line, terminals, ground electrodes, and system alternatives. For the transmission line component, disturbances were calculated for each alternative route segment so that any combination of these segments could be used to analyze impacts of alternative routes. The transmission line and terminal disturbance spreadsheets were modified as appropriate for each system alternative.

TABLE A-1 TWE PROJECT COMPONENTS DESIGN CHARACTERISTICS USED IN DISTURBANCE ESTIMATES	
± 600 KV DC TRANSMISSION LINE	
Physical Properties	
Line Length	Miles per route segment
Structure Type[14]	Self supporting steel lattice
Span Length	900 to 1,500 feet
Number of Structures per Mile	Approximately four
ROW Width	250 feet
Land Temporarily Disturbed	
Structure Work Area	ROW width (250 ft) x 200 feet per structure
Wire-Pulling, Tensioning and Splicing Sites	ROW width (250 ft) x 500 feet for dead-end structure (two sites at every dead-end structures) ROW width (250 ft) x 500 feet for mid-span conductor and shield wire (approximately every 9,000 feet) 100 x 500 feet for fiber optic cable set-up sites (approximately every 18,000 feet)
Material Storage Yards	20 acres every 30 miles of line
Staging Areas / Fly Yards	7 acres every 5 miles of line
Batch Plant Sites	5 acres every 15 miles of line
Land Permanently Disturbed	
Structure Base	Self Supporting Lattice (tangent) - 900 square feet (30 x 30 feet tower base) Self Supporting Lattice (angle) - 1,225 square feet (35 x 35 feet tower base) Self Supporting Lattice (dead-end) - 1,600 square feet (40 x 40 feet tower base)
Regeneration Sites	10,000 square feet (100 x 100 feet) every 50 miles of line
New Access Roads	See Section 3.5.2.1 Access Road Construction and Appendix A Access Road Methodology
NORTHERN AND SOUTHERN TERMINALS	
Physical Properties of Interconnection Lines	

[14] Tangent self supporting lattice structures were used to calculate disturbance since this structure type would result in greater disturbances per structure than the proposed guyed lattice structure. Structure types to be used in site-specific settings will be determined during engineering and design of the Agency Preferred Alternative.

TABLE A-1 TWE PROJECT COMPONENTS DESIGN CHARACTERISTICS USED IN DISTURBANCE ESTIMATES	
Line Length	Miles per interconnection line
Structure Type	Self supporting steel lattice for 500 kV line Single pole tubular steel for 230 kV line
Number of Structures per Mile	Approximately six (230 kV structure) and four (500 kV structure)
ROW Width	100 feet for 230 kV line 250 feet for 500 kV line
	Land Temporarily Disturbed
Storage and Concrete Batch Plant	7.5 acres
Structure Work Areas for Interconnection Lines	200 x 200 feet per 230 kV structure; approximately 6 per mile of line (N. Terminal only) 250 x 200 feet per 500 kV structure; approximately 4 per mile of line
Wire-Pulling, Tensioning and Splicing Sites for Interconnection Lines	ROW width x 500 feet – mid-span conductor and shield wire sites every 9,000 feet and fiber optic set-up sites every 18,000 feet
	Land Permanently Disturbed
Converter Station and Switchyards	205 acres (N. Terminal), 140 acres (S. Terminal)
Structure Base 500 kV Interconnection Line	Self Supporting Lattice (tangent) – 1,225 square feet (35 x 35 feet tower base) Self Supporting Lattice (angle) - 1,600 square feet (40 x 40 feet tower base) Self Supporting Lattice (dead-end) – 2,025 square feet (45 x 45 feet tower base)
Structure Base 230 kV Interconnection Line	Single Pole Tubular (tangent) - 40 square feet Single Pole Tubular (angle) - 45 square feet Single Pole Tubular (dead-end) – 50 square feet
New Access Roads	See Section 3.5.2.1 Access Road Construction and Appendix A Access Road Methodology
	GROUND ELECTRODES
	Physical Properties of Overhead Electrode Lines
Line Length	Miles per electrode line
Structure Type	Wood poles for low voltage 34.5 kV line
Number of Structures per Mile	18
ROW Width	50 feet
	Land Temporarily Disturbed
Ground Electrode Site	65 acres
Material Storage Yards	10 acres (one at each electrode site)
Structure Work Areas for 34.5 kV Line	ROW (50 ft) x 100 feet
Wire-Pulling, Tensioning and Splicing Sites for Interconnection Lines	75 x 150 feet – two at every dead-end 75 x 100 feet – mid-span conductor site every 9,000 feet
	Land Permanently Disturbed
Ground Electrode Site	0.5 acres
Well Access	5 acres

TABLE A-1 TWE PROJECT COMPONENTS DESIGN CHARACTERISTICS USED IN DISTURBANCE ESTIMATES	
Structure Base 34.5 kV Line	Wood pole (tangent) - 16 square feet Wood pole (angle) - 25 square feet plus 25 square feet per anchor (2 per structure location) Wood pole (dead-end) – 36 square feet plus 25 square feet per anchor (4 per structure location)
New Access Roads	See Section 3.5.2.1 Access Road Construction and Appendix A Access Road Methodology

MEMORANDUM

DATE:	March 1, 2011
TO:	David Smith Garry Miller Chris Keller
C:	Ron Carrington Sarah Doering Pushkar Gokhale Dan Cacioppo DMS 115841/ PER 01
FROM:	Linda Erdmann
SUBJECT:	115841 Trans West Express Transmission Project – Access Road Methodology

MESSAGE

This memo provides a description of the base data and methodology that will be used to estimate miles of access roads and percentages of these access roads inside and outside the transmission line right-of-way (ROW) by route segment for the Proposed and Alternative Routes. This data will ultimately be used to approximate the area of ground disturbance associated with new access roads within the Proposed and Alternative Route corridors by route segment in four different types of terrain:

- Terrain Type 1 - Flat
- Terrain Type 2 - Rolling
- Terrain Type 3 - Steep
- Terrain Type 4 - Mountainous

Backbone Access Road Network Methodology

The first step in this process is to identify existing roads in the project area that can be used to access the Proposed and Alternative Route corridors for transmission line construction and maintenance. These public and private roads make up the backbone access road network that includes paved, gravel, and dirt roads.

Google Earth was used to determine the location of existing access roads for the Proposed and Alternative Routes. Existing paved roads are assumed to require no improvements and therefore no ground disturbance. These roads are categorized as Category 1 Existing Improved Roads. Existing gravel and dirt roads that appear to have wide, well graded or graveled surfaces are assumed to require no improvements and therefore no ground disturbance. These roads are also categorized as Category 1 Existing Improved Roads.

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Existing dirt roads that appear to have narrow, poorly graded surfaces or that appear as two-track paths are assumed to require improvement and therefore ground disturbance. These roads are categorized as either Category 2A Existing Roads Outside the Corridor that Require Improvement or Category 2B Existing Roads Inside the Corridor that Require Improvement.

Category 1 Existing Improved Roads and Category 2A Existing Roads Outside the Corridor that Require Improvement make up the backbone access road network. Category 2B Existing Roads Inside the Corridor that Require Improvement are considered new access roads and are included in the indicative access road summary by terrain type described in the next section.

A GIS shapefile was created for the backbone access road network for the Proposed and Alternative Routes. The purpose of the backbone access road GIS shapefile is twofold:

1. Identify lengths of Category 1 and Category 2A roads that can be used to access the Proposed and Alternative Route corridors for transmission line construction and maintenance.
2. Identify the starting point for the layout and location of new access roads (Categories 2B, 3, 4, 5, & 6).

New Access Road Methodology

New access roads were identified and mapped along sample segments of the Proposed Route (June 2010) in order to determine the indicative length of new access roads required for the Proposed and Alternative Routes. This approach will provide the information necessary to analyze and compare impacts from construction of the access roads for the Proposed and Alternative Routes in the EIS. The new access roads and backbone access roads described previously will provide the complete road network necessary to construct the TWE transmission line.

POWER's construction managers reviewed hard copy USGS 7.5-minute quadrangle topographic maps with the entire length of the Proposed Route shown. Segments along the Proposed Route that represented the different terrain types that would require new access road construction were identified. A total of 18 sample segments were identified which represented flat, rolling, steep and mountainous terrain. Six of the 18 sample segments, 1, 7, 13, 15, 17 and 18 have more than one type of terrain as shown in Table 1.

Once these sample segments were selected, indicative structure spotting based on topographic constraints and spans ranging from 1200 to 1400 feet were completed and access roads were hand drawn on the hard copy USGS quad maps using the contours. These maps were then scanned, geo-referenced and the roads digitized into the GIS.

Once in the GIS, the location of the digitized access roads were re-examined by the construction managers to identify any potential digitizing scale errors. For example, if a new

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access road was located just outside the 250 foot ROW in flat terrain, the location of the road was corrected to be within the ROW as intended. The corrected access roads were labeled by terrain category (Categories 3, 4, 5 & 6) and sample segment number.

The 18 sample segments were analyzed for slope in tenth mile increments, using 6 meter DEMs derived from the TWE Towill elevation data. Tenth mile increments were used to obtain 10 data points or values per one mile of sample segment length. This provides a more accurate terrain measurement compared to one data point or value per one mile increment over the total length of the sample segment. This slope analysis provided the minimum, maximum, and average slope and cumulative change in slope for each tenth mile increment, which was then compared to topographic maps for accuracy. In steeper terrain areas, the average slopes were often less than the actual terrain where the flatter sample segments in the mountainous areas had distorted the greater slope values. For example, in Sample Segment 10, all of the average slope values ranked as “steep” or “rolling”, although both the topographic map and Google Earth show the areas to be clearly mountainous. In addition, the minimum and maximum slopes did not always represent actual terrain. Therefore, it was determined that the cumulative change in slope best represented all terrain types and was used for each tenth mile increment.

The cumulative change in slope for each tenth mile increment over a length of a mile (10 tenth mile increments) is then averaged to calculate the slope value and terrain type per mile of sample segment. This data is then entered into an Excel spreadsheet to compare the percentage change in slope value and terrain type for successive one mile sections of the sample segment. These sections are then grouped by average slope value and dominant terrain type. Therefore, each sample segment can have more than one dominant terrain type.

Miles of sample segments with dominant slopes between 0 to 8 percent are categorized as Flat Terrain; 8 to 15 percent as Rolling Terrain; 15 to 25 percent as Steep Terrain; and over 25 percent as Mountainous Terrain. Roads within these four terrain types are categorized as follows:

- Category 3 Construct Road in Flat Terrain (0 to 8 percent slope)
- Category 4 Construct Road in Rolling Terrain (8 to 15 percent slope)
- Category 5 Construct Road in Steep Terrain (15 to 25 percent slope)
- Category 6 Construct Road in Mountainous Terrain (greater than 25 percent slope)

The miles of transmission line, new access roads, new road within the ROW, and new road outside the ROW were calculated for each sample segment and totaled by terrain type (Table 1). The ratio of line miles to road miles by terrain type will be applied to the Proposed and Alternative Routes to estimate the miles of new access roads required by route segment. For example, if Alternative Route segment X from mile 10 to mile 20 is predominantly flat, then using the ratio shown in Table 1 for Category 3 Flat Terrain, which is 1.3, the 10 miles of transmission line for Alternative Route segment X would require approximately 13 miles of new access roads.

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Determination of the dominant terrain type along Proposed and Alternative Route segments will require the same GIS slope analysis in tenth mile increments as described above for the sample segments. The cumulative change in slope percentages for each tenth mile increment will be mapped according to terrain type: Flat (0 to 8 percent slope), Rolling (8 to 15 percent slope), Steep (15 to 25 percent slope), and Mountainous (greater than 25 percent slope). Demarcation of the dominant terrain along the extent of the route segment will require analysis of the slope data as described above. Terrain Sample Maps for Sample Segments 1 to 18 are provided which show the cumulative change in slope percentages for each tenth mile increment, miles of terrain type, backbone access network, and indicative structures and access roads. GIS shapefiles of this data is also provided.

The ROW data by terrain category will also be applied to the Proposed and Alternative Routes to estimate the percentage of new roads that would be within the ROW and outside the ROW. In general, roads in flat terrain are most likely to be located within the ROW than those in steep terrain due to topography constraints. So for the example given above, approximately 9.23 miles or 71 percent of the new access roads required would be within the ROW and approximately 3.77 miles or 29 percent would be outside the ROW (Table 1).

This approach substantially reduces the time and effort needed to conduct the impact analysis from access road construction in the EIS since the process of indicative spotting, locating, and mapping new access roads as done for the sample segments along the Proposed Route will not be required for the entire length of the Proposed and Alternative Routes.

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TABLE 1 INDICATIVE ACCESS ROAD SUMMARY BY TERRAIN TYPE

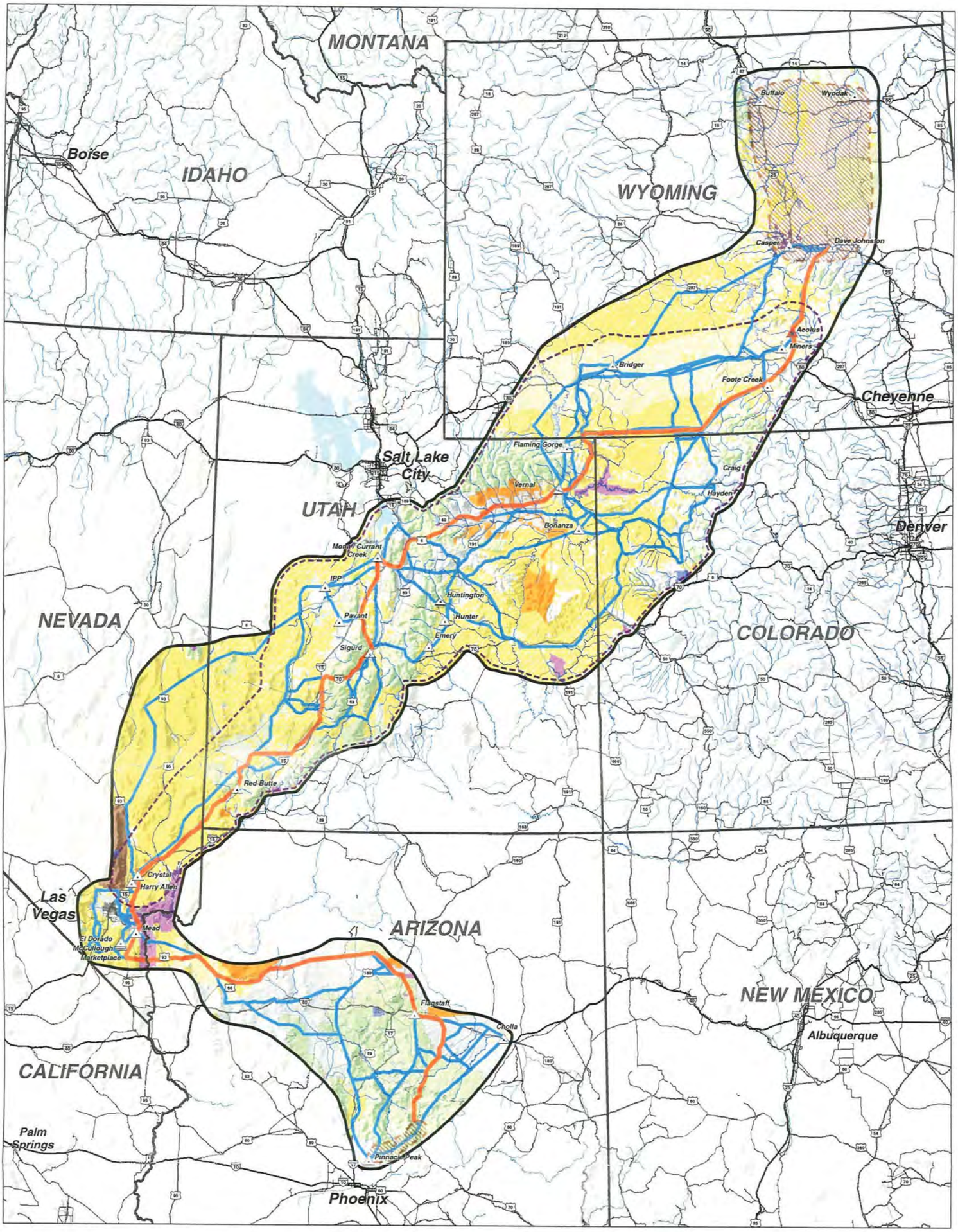
SAMPLE SEGMENT	PROPOSED ROUTE SEGMENT	MILEPOST		LINE LENGTH (MILES)	NEW ACCESS ROAD LENGTH (MILES)**	ROAD IN ROW (MILES)	ROAD OUTSIDE ROW (MILES)	AVERAGE CUMULATIVE CHANGE IN SLOPE (%)	TERRAIN TYPE	RATIOS BY TERRAIN TYPE			ROW BY TERRAIN TYPE	
		BEGIN	END							TOTAL LINE LENGTH (MILES)	TOTAL ACCESS ROAD LENGTH (MILES)	RATIO	TOTAL ACCESS ROADS IN ROW (MILES / %)	TOTAL ACCESS ROADS OUTSIDE ROW (MILES / %)
11	U165	10	20	10	10.54	10.0	0.5	2%	Terrain Type 1 Flat	84.5	108.7	1.3	77.4 / 71%	31.3 / 29%
12	U255	15	25	10	13.75	9.4	4.4	1%						
14	N45	0	11	11	13.56	9.7	3.9	3.2%						
15	N70	3	11	8	12.03	7.7	4.3	2.7%						
1	W10	9	15	6	8.19	6.2	2.0	5.5%						
18	N165	4.5	6	1.5	1.58	1.1	0.5	6.5%						
2	W10	20	31	11	18.44	10.3	8.1	5%						
3	W25	0	10	10	8.91	8.6	0.3	2%						
4	W25	20	30	10	10.97	9.2	1.8	7%						
7	U55	53	60	7	10.72	5.3	5.4	6%						
17	N135	0	1	1	0.36	0.24	0.1	11.1	Terrain Type 2 Rolling	29.5	39.8	1.4	23.5 / 59%	16.2 / 41%
5	C60	5	15	10	15.51	9.3	6.1	9%						
6	C85	15	25.2	10.2	14.52	5.8	8.7	10.5%						
16	N100	0	7.3	7.3	8.63	7.7	0.8	9.5%						
18	N165	0	1	1	0.75	0.6	0.2	13.2%						
1	W10	5	9	4	8.45	3.1	5.4	18%	Terrain Type 3 Steep	21.2	39.2	1.8	14.4 / 36%	24.8 / 64%
7	U55	50	53	3	7.65	2.3	5.4	16.3%						
15	N50_S2	30	34.2	4.2	6.61	3.23	3.4	22.5%						
15	N70	0	3	3	5.02	2.24	2.8	18.2%						
13	U255	49	56	7	11.44	3.5	7.9	21.1%						
8	U55	80	90	10	29.03	4.4	24.6	38%	Terrain Type 4 Mountainous	42.3	120.4	2.8	19.4 / 16%	101 / 84%
9	U70	0	10	10	28.63	3.8	24.8	40.5%						
10	U70	25	37	12	28.87	6.2	22.7	28%						
13	U255	45	49	4	16.23	1.5	14.7	28%						
17	N135	1	3.8	2.8	4.73	1.5	3.2	28.1%						
18	N165	1	4.5	3.5	12.86	2.1	10.8	27.2%						

Notes: **Miles of New Access Road Length includes Category 2B Existing Roads Inside Corridor that Require Improvement
Terrain Type 1 Flat (0 to 8 percent slope)
Terrain Type 2 Rolling (8 to 15 percent slope)
Terrain Type 3 Steep (15 to 25 percent slope)
Terrain Type 4 Mountainous (greater than 25 percent slope)

APPENDIX B

Supplemental Map Exhibits B-1 to B-6

- B-1 Preliminary Right-of-Way Application Corridors, November 2007.
- B-2 Proposed and Alternative Routes, Amended SF-299 Application, December 2008.
- B-3 Proposed and Alternative Routes, Las Vegas Area, Amended SF-299 Application, December 2008.
- B-4 Proposed and Alternative Routes, Amended SF-299 Application, January 2010.
- B-5 Proposed and Alternative Routes, Las Vegas Area, Amended SF-299 Application, January 2010.
- B-6 Proposed and Alternative Corridors, Amended POD, July 2010.



Legend

- Terminal Siting Area
- Preliminary Proposed Corridor
- Preliminary Alternative Corridor
- Bureau of Land Management
- Bureau of Indian Affairs
- U.S. Forest Service
- National Park Service
- Department of Defense
- U.S. Fish & Wildlife Service
- Bureau Of Reclamation
- State/Private

Reference Features

- Interstate
- Highway
- Major Road
- Railroads
- Major River
- Major Lake
- State Boundary
- TransWest Express Study Area
- Gateway South Study Area
- Substation
- New Substation

Data Sources

Land Ownership:
BLM Denver Service Center, 2006
BLM - National Atlas, 2006, EPG Inc, 2007

NOTE: Substation locations are schematics and do not necessarily represent precise locations. Preliminary transmission line corridors generally follow existing or planned transmission lines; however, the existing transmission lines are not depicted on the map for graphical clarity.

0 15 30 60 90 120
Miles

Working Draft: November 30, 2007

N:\projects\nationalgrid\gateway\corridor_analysis\mxds\basemap.mxd

Figure 5

Preliminary Right-Of-Way Application Corridors

TransWest Express Transmission Project

nationalgrid APS ROCKY MOUNTAIN POWER

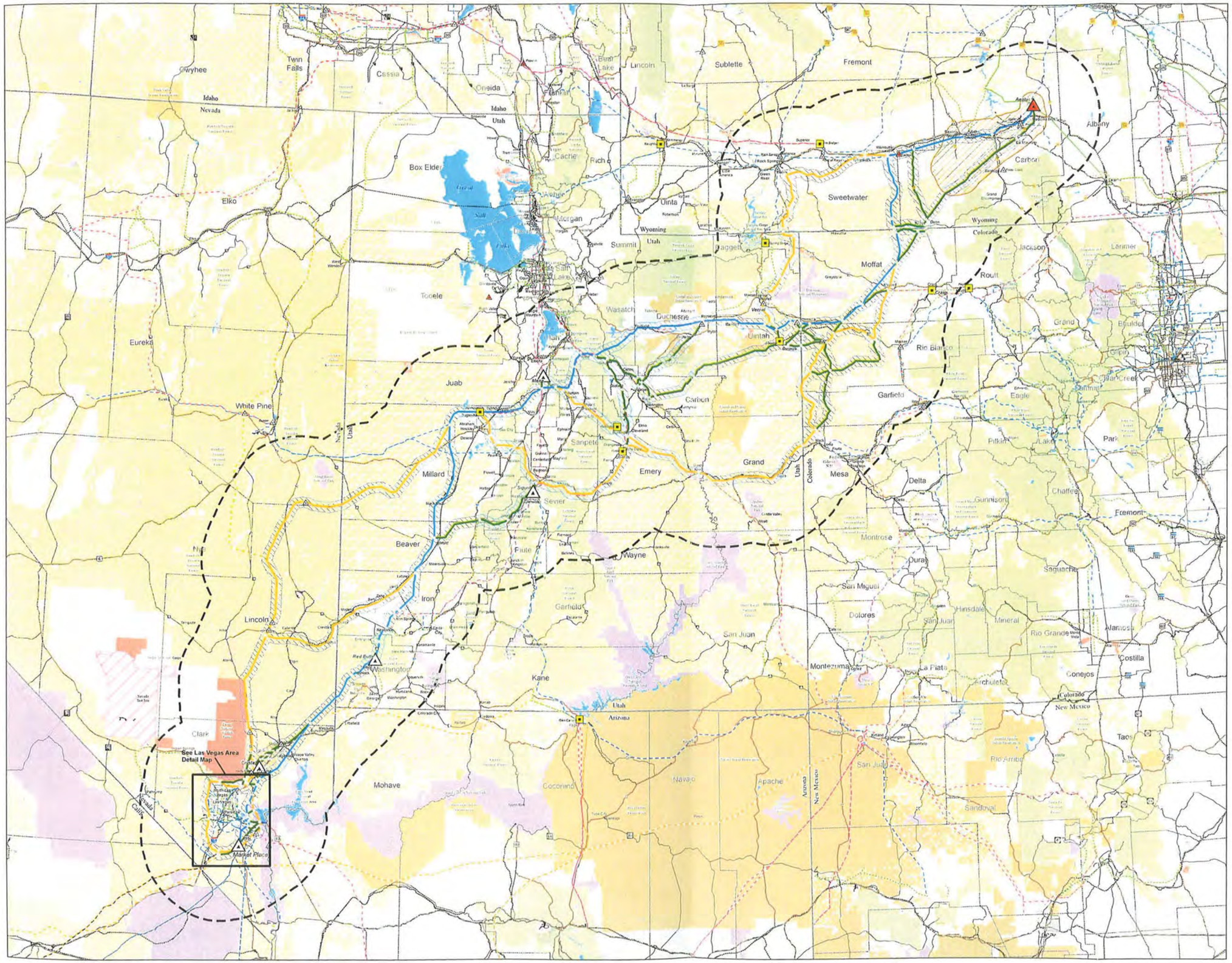


FIGURE 1
PROPOSED AND ALTERNATIVE ROUTES

Legend

Land Jurisdiction

- Bureau of Land Management
- Indian Reservation
- U.S. Forest Service
- National Park Service
- U.S. Fish & Wildlife Service
- Department of Defense
- Bureau of Reclamation
- Department of Energy
- State Land
- Private Land

Project Features

- Proposed Substation (Permitting in Progress)
- Study Area Boundary
- Proposed Route
- Proposed Alternative Route
- Alternatives Under Further Consideration
- 6 Mile Wide Corridor Buffer
- Link Node
- Terminal Siting Area

Utility Facilities

- Existing Power Plant
- Existing Substation
- 500kV+/- DC Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230kV Transmission Line
- 115/138kV Transmission Line

Transportation Features

- Interstate Highway
- US Highway
- State Highway
- Railroad

Water Features

- River or Stream
- Lake, Pond, or Reservoir

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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NOTE: Substation locations are schematic and do not necessarily represent precise locations.

Print Date December 12, 2008

DRAFT

0 12.5 25 50 75 100 Miles

TRANSWEST EXPRESS TRANSMISSION LINE PROJECT

TRANSWEST EXPRESS LLC

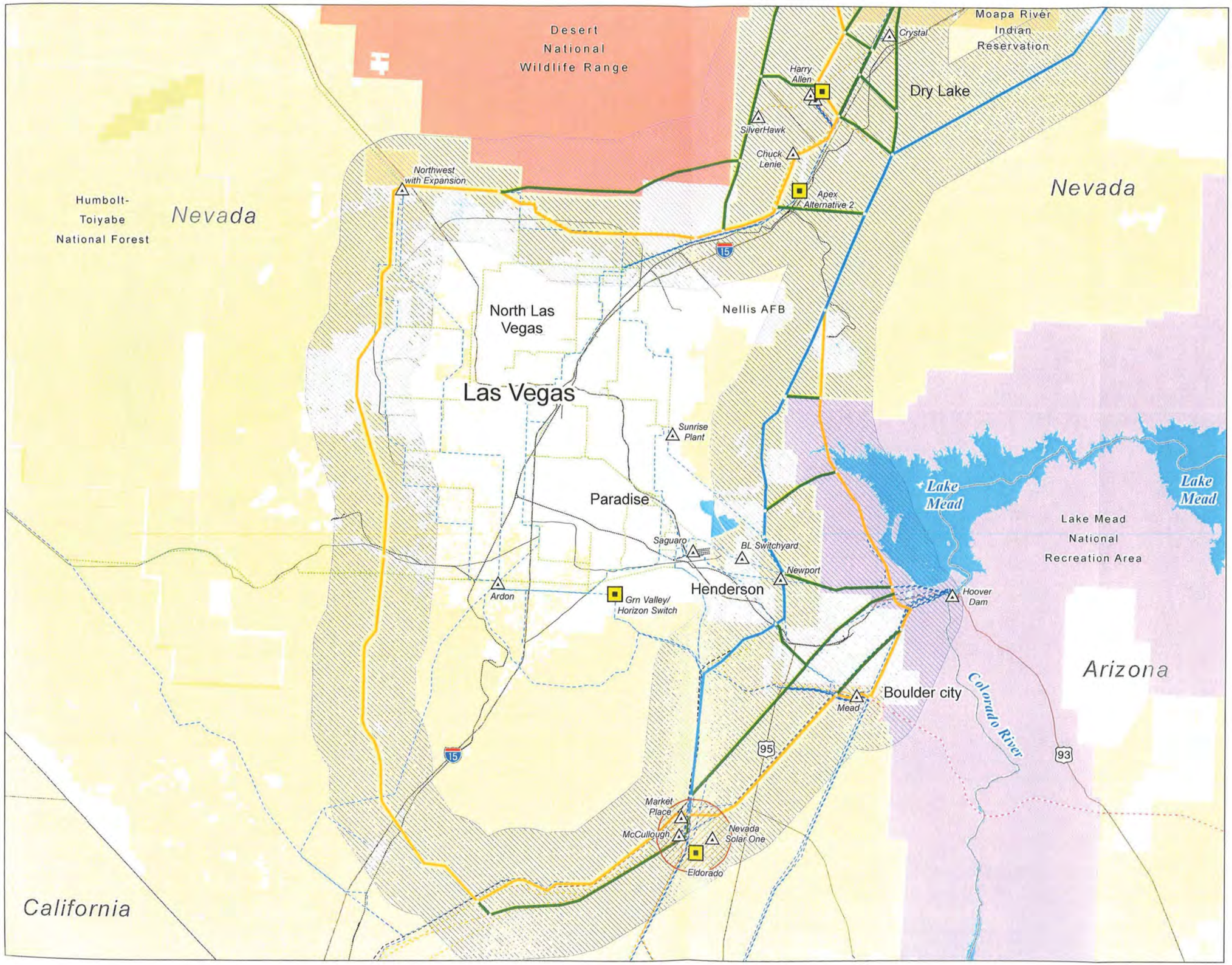

FIGURE 2
PROPOSED AND ALTERNATIVE ROUTES LAS VEGAS AREA

Legend

Land Jurisdiction

- Bureau of Land Management
- Indian Reservation
- U.S. Forest Service
- National Park Service
- U.S. Fish & Wildlife Service
- Department of Defense
- Bureau of Reclamation
- Department of Energy
- State Land
- Private Land

Project Features

- Proposed Route
- Proposed Alternative Route
- Alternatives Under Further Consideration
- 6 Mile Wide Corridor Buffer
- Link Node
- Terminal Siting Area

Utility Facilities

- Existing Power Plant
- Existing Substation
- 500kV+/- DC Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230kV Transmission Line
- 115/138kV Transmission Line

Transportation Features

- Interstate Highway
- US Highway
- State Highway
- Railroad

Water Features

- River or Stream
- Lake, Pond, or Reservoir

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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NOTE: Substation locations are schematic and do not necessarily represent precise locations.

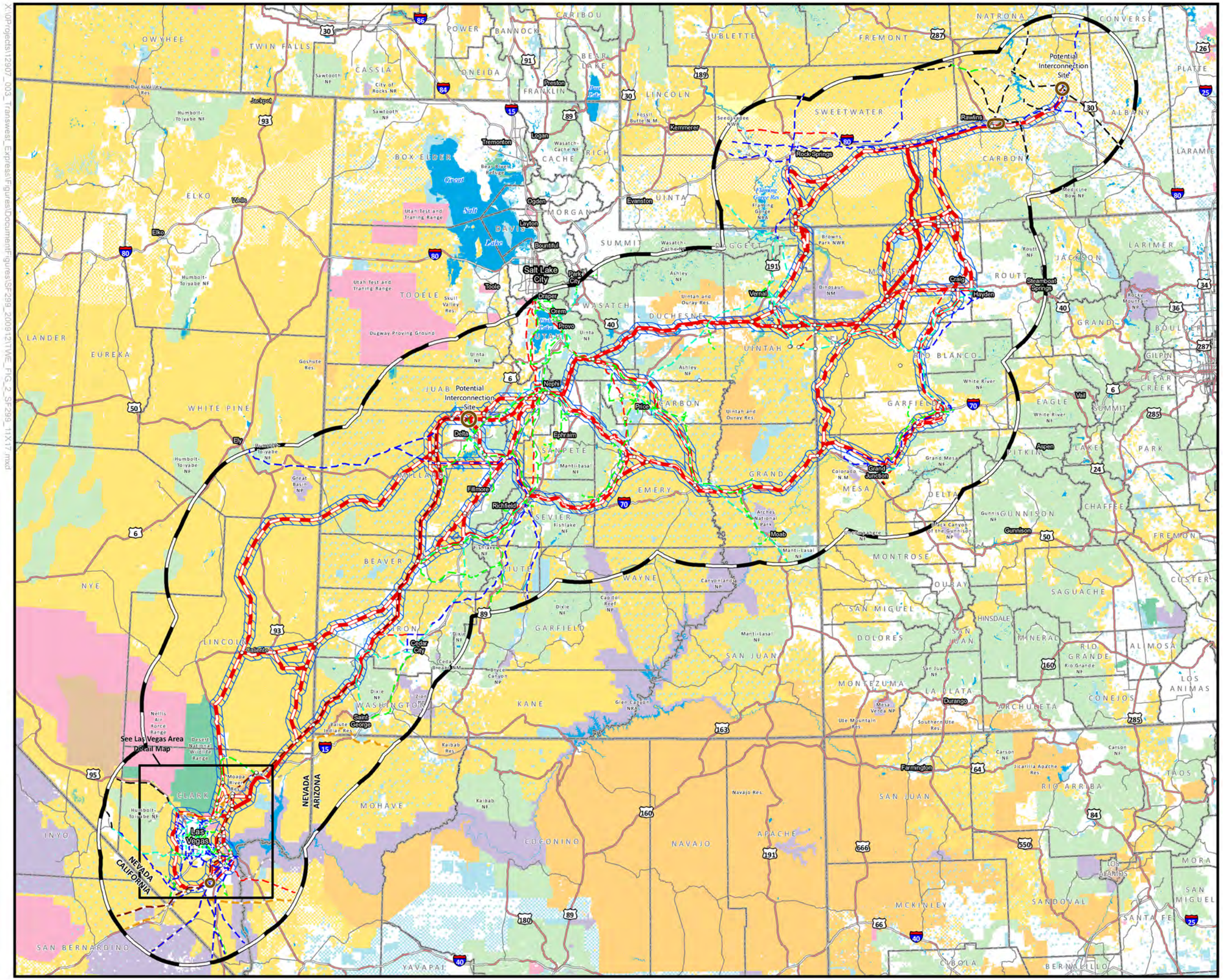
Print Date December 12, 2008

DRAFT

0 1.25 2.5 5 7.5 10 Miles

TRANSWEST EXPRESS TRANSMISSION LINE PROJECT

TRANSWEST EXPRESS LLC



MAP EXHIBIT B-4
PROPOSED AND ALTERNATIVE ROUTES

Legend

Project Features
- Proposed Route
- Proposed Alternatives
- Link Node
- 6-Mile-Wide Corridor
- Study Area
- Terminal Siting Area

Utility Facilities
- 500kV +/- Direct Current Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230 to 287kV Transmission Line
- 138 to 161kV Transmission Line
- 115kV Transmission Line
- Below 100kV Transmission Line
- Unknown Voltage Transmission Line

Transportation Features
- Interstate Highway
- U.S. Highway
- State Highway

Water Features
- Perennial Water Bodies

Land Jurisdiction
- Department of Defense
- Department of Energy
- Indian Reservation
- State Land
- USDA Forest Service
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service
- USDI National Park Service

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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Print Date : January 22, 2010

0 20 40 80 120
Miles

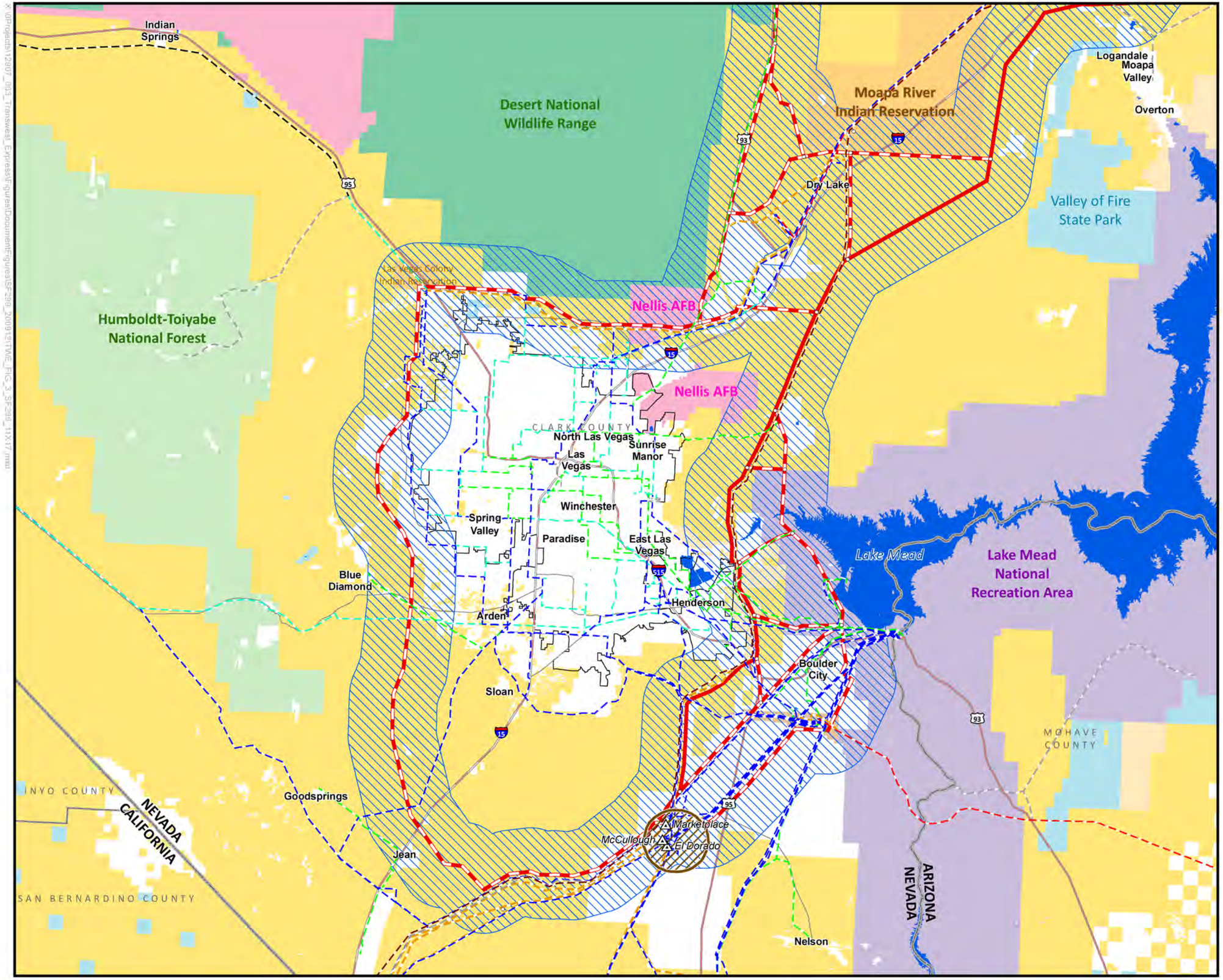
TRANSWEST EXPRESS
TRANSMISSION PROJECT

NATIONAL SYSTEM OF PUBLIC LANDS

TRANSWEST EXPRESS LLC

X:\Projects\12907_003_Transwest_Express\Figures\Document\Figures\SF299_20091210TWE_FIG_2_SF299_11X17.mxd

MAP EXHIBIT B-5
PROPOSED AND ALTERNATIVE ROUTES LAS VEGAS AREA



Legend

Project Features
- Proposed Route
- Proposed Alternatives
- Link Node
- 6-Mile-Wide Corridor
- Study Area
- Terminal Siting Area

Utility Facilities
- Project Substation
- 500kV +/- Direct Current Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230 to 287kV Transmission Line
- 138 to 161kV Transmission Line
- 115kV Transmission Line
- Below 100kV Transmission Line
- Unknown Voltage Transmission Line

Transportation Features
- Interstate Highway
- U.S. Highway
- State Highway

Water Features
- Perennial Water Bodies

Land Jurisdiction
- Department of Defense
- Department of Energy
- Indian Reservation
- State Land
- USDA Forest Service
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service
- USDI National Park Service

Data Sources

Transportation:
NTAD2008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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Print Date : January 22, 2010

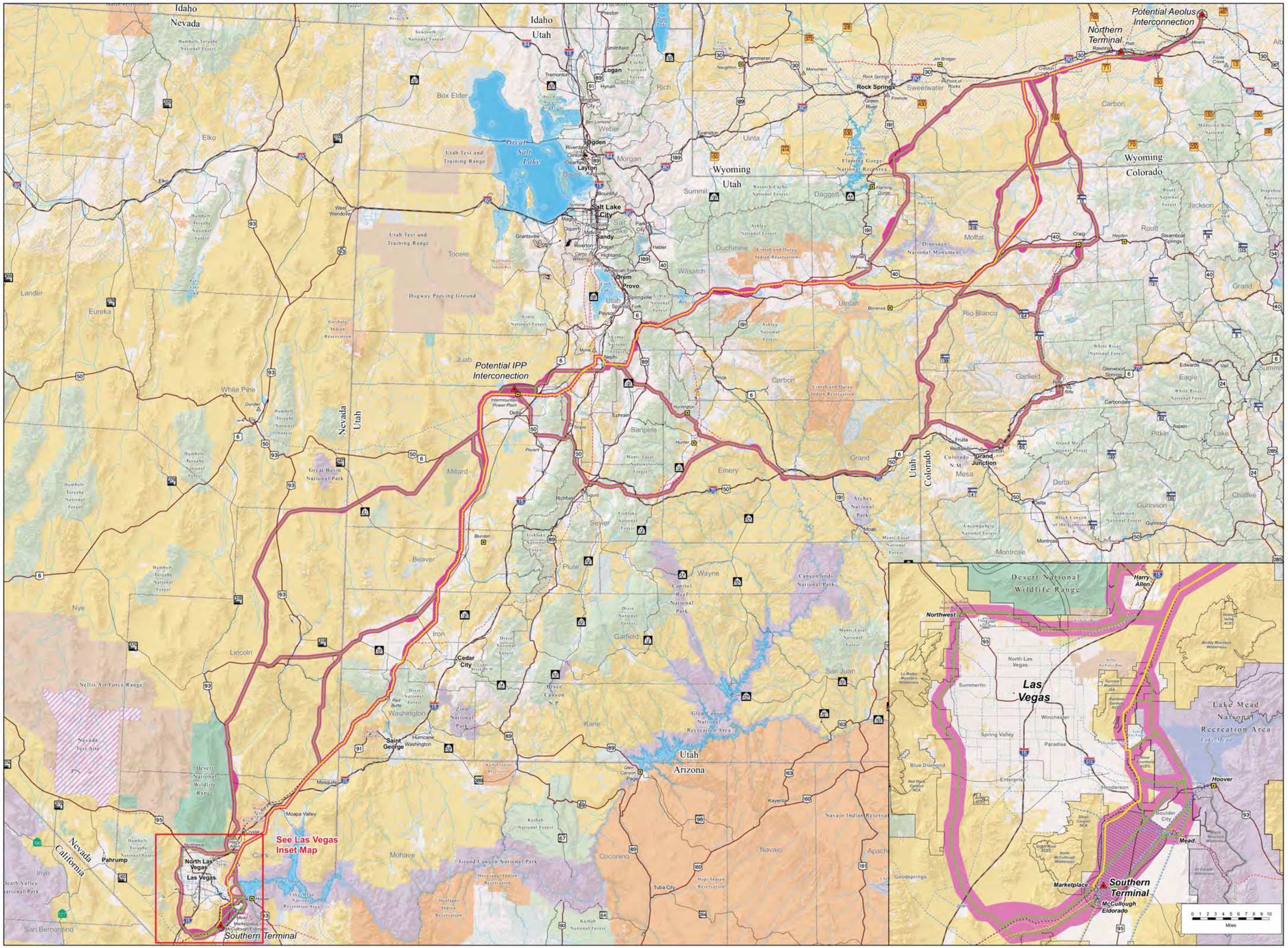
0 2.5 5 10 15
Miles

TRANSWEST EXPRESS TRANSMISSION PROJECT

NATIONAL SYSTEM OF PUBLIC LANDS

TRANSWEST EXPRESS LLC

MAP EXHIBIT B-6
PROPOSED AND ALTERNATIVE CORRIDORS



Legend

Project Features

- Proposed Segment
- Alternative Segment
- Proposed & Alternative Corridors (Typical two miles wide)
- Proposed Substation/ Terminal
- Terminal Siting Area

Land Jurisdiction

- Department of Defense
- Department of Energy
- Indian Reservation
- USDA Forest Service
- USDI Bureau of Land Management
- USDI Bureau of Reclamation
- USDI Fish and Wildlife Service
- USDI National Park Service
- State Land
- State or Local Park
- Private Land

Existing Utilities

- Existing Power Plant
- Existing Substation
- 500kV+/- DC Transmission Line
- 500kV Transmission Line
- 345kV Transmission Line
- 230 to 287kV Transmission Line
- 138 to 161kV Transmission Line
- 115kV Transmission Line

Transportation Features

- Interstate Highway
- US Highway
- State Highway
- Railroad

Water Features

- River or Stream
- Lake, Pond, or Reservoir

Data Sources

Transportation:
NTA02008, US Department of Transportation
Land Jurisdiction:
BLM State Office California, Colorado, Idaho, New Mexico, Oregon, Utah, Wyoming 2008
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NOTE: Substation locations are schematic and do not necessarily represent precise locations.

Date updated: June 29, 2010
Routes Current as of June 23, 2010

The routes shown on this map are preliminary and may be revised and/or refined throughout the development of the project.

0 10 20 30 40 50 60 70 80
Miles
1:800,000

TRANSWEST EXPRESS TRANSMISSION PROJECT

POWER ENGINEERS
June 29, 2010

TRANSWEST EXPRESS LLC

APPENDIX C

Supplemental Information – TWE Project Vegetation Management Program

- Table C-1 TWE Project DEIS Vegetation Management Guidelines by Vegetation-Land Cover Type - Response to AECOM December 10, 2010 Data Request Number 1.5

- Figure C-1 Figure C-1 Photographs of Level 3 Vegetation Management

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
Montane Forest SO28, SO32 - Douglas fir - Subalpine fir - Engelmann spruce - Aspen	60 to 80 feet	50 to 150 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *ROW Wire Zone* – Same as Level 1. Cleared from ROW *ROW Border Zone* - Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *ROW Wire Zone -* Same as Level 1. Managed for low growing shrubs and herbs. *ROW Border Zone* – managed for compatible vegetation types, heights and densities, including trees, shrubs and herbs, based on allowed types, heights and densities.	Construction Phase: *ROW Wire Zone -* Selectively cleared based on allowed vegetation types, heights and densities. *ROW Border Zone -* Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *ROW Wire Zone -* Managed for compatible vegetation, including trees, shrubs and herbs, based on allowed types, heights and densities. *ROW Border Zone –* Managed for compatible vegetation, including trees, shrubs and herbs, based on allowed types, heights and densities.
Aspen SO 23	30 to 70 feet	30 to 60 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *ROW Wire Zone* – Same as Level 1. Cleared from ROW *ROW Border Zone* – Same	Construction Phase: *ROW Wire Zone -* Selectively cleared based on allowed heights and densities.

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
				as Level 1. Cleared from ROW. Operation Phase: *ROW Wire Zone -* Same as Level 1. Managed for low growing shrubs and herbs. *ROW Border Zone* – managed for allowed tree heights and densities.	*ROW Border Zone -* Selectively cleared based on allowed heights and densities. Operation Phase: *ROW Wire Zone -* Managed for allowed vegetation, including shrub and types, heights and densities. *ROW Border Zone –* Managed for allowed vegetation, including shrub and tree types, heights and densities.
Ponderosa Pine SO36	40 to 90 feet	30 to 100 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *ROW Wire Zone* – Same as Level 1. Cleared from ROW *ROW Border Zone* - Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *ROW Wire Zone -* Same as Level 1. Managed for low	Construction Phase: *ROW Wire Zone -* Selectively cleared based on allowed heights and densities. *ROW Border Zone -* Selectively cleared based on allowed heights and densities. Operation Phase:

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
				growing shrubs and herbs. *ROW Border Zone* – managed for allowed tree heights and densities.	*ROW Wire Zone -* Managed for allowed vegetation, including shrub and types, heights and densities. *ROW Border Zone –* Managed for allowed vegetation, including shrub and tree types, heights and densities.
Pinyon Juniper SO39, SO40, SO52 - Pinyon pine Utah Juniper	15 to 40 feet	100 to 300 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *ROW Wire Zone* – Same as Level 1. Cleared from ROW *ROW Border Zone* - Selectively cleared based on allowed heights and densities. Most pinyon juniper would be allowed in the border zone. Operation Phase: *ROW Wire Zone -* Same as Level 1. Managed for low growing shrubs and herbs. *ROW Border Zone* – managed for allowed tree heights and densities.	Construction Phase: *ROW Wire Zone -* Selectively cleared based on allowed heights and densities. Most pinyon juniper would be allowed in the wire zone. *ROW Border Zone -* Selectively cleared based on allowed heights and densities. Most pinyon juniper would be allowed in the border zone. Operation Phase: *ROW Wire Zone -* Managed for allowed vegetation, including shrub and tree types, heights and densities.

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
					ROW Border Zone – Managed for allowed vegetation, including shrub and tree types, heights and densities.
Mountain Shrubland SO46 - Gambel oak - Serviceberry - Mountain-mahogany - Chokecherry	8 to 15 feet	20 to 50 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	Construction Phase: *ROW Wire Zone* – Same as Level 1. Cleared from ROW *ROW Border Zone* - Selectively cleared based on allowed heights and densities. Most shrubs would be allowed in the border zone. Operation Phase: *ROW Wire Zone -* Same as Level 1. Managed for low growing shrubs and herbs. *ROW Border Zone* – managed for allowed shrub heights and densities.	Construction Phase: *ROW Wire Zone -* Selectively cleared based on allowed heights and densities. Most shrubs would be allowed in the wire zone, except along access roads and structure clearance sites. *ROW Border Zone -* Selectively cleared based on allowed heights and densities. Most shrubs would be allowed in the border zone, except along access roads and structure clearance sites. Operation Phase: *ROW Wire Zone -* Managed for allowed vegetation, including shrub types, heights and densities.

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
					ROW Border Zone – Managed for allowed vegetation, including shrub types, heights and densities.
Sagebrush Shrubland SO54, SO55, SO56 - Big sagebrush - Silver sagebrush - Black sagebrush	2 to 6 feet tall	20 to 50 years	Construction Phase: Retained in ROW except where fuel load is too great; and along access roads and construction sites. Operation Phase: ROW managed for low growing shrubs and herbs.	NOT APPLICABLE	NOT APPLICABLE
Desert Shrubland SO45, SO60, SO65, SO69 Cold Desert: - Greasewood - Rabbitbrush - Saltbush species Warm Desert: - Creosote bush - Burro bush - Josha trees	1 to 6 feet tall Josha trees – 20 feet; Salt bush – less than 1 foot; Average – 3 feet	Cold desert: 30 to 50 years Warm desert: 50 to 200 years	Construction Phase: Retained in ROW except where fuel load is too great; and along access roads and construction sites. Joshua trees would be retained, except for center span of wire zone. Operation Phase: ROW managed for low growing shrubs and herbs. Joshua trees would be retained, except for center span of wire zone.	NOT APPLICABLE	NOT APPLICABLE

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
Riparian SO96, S118 - Cottonwoods - Willows - River birch - Boxelder - Willow	Trees – 30 to 60 feet (if present) Shrubs – 5 to 15 feet	Trees – 50 to 80 years Shrubs – 5 to 20 years	NOT APPLICABLE	NOT APPLICABLE	Construction Phase: Retained in ROW except where fuel load is too great; or where conductor clearances cannot be maintained. Riparian areas would be avoided by access roads and construction sites to the extent feasible. Trees would be retained, except for center span of wire zone. *ROW Wire Zone and Border Zone -* Selectively cleared based on allowed vegetation types, heights and densities. Operation Phase: *ROW Wire Zone and Border Zone -* Managed for compatible vegetation, including trees, shrubs and herbs, based on allowed types, heights and densities.
Wetland SO96 - Greasewood - Saltbush	2 to 5 feet	20 to 40 years	NOT APPLICABLE	NOT APPLICABLE	Construction Phase: Retained in ROW except where impacts are unavoidable (e.g. limited

TABLE C-1 TWE PROJECT DEIS VEGETATION MANGEMENT GUIDELINES BY VEGETATION LAND COVER TYPE RESPONSE TO AECOM DECEMBER 10, 2010 DATA REQUEST NUMBER 15					
VEGETATION LAND COVER TYPE/ AND DOMINANT SPECIES*	HEIGHT RANGE	REGENERATION TIME TO FORMER HEIGHT (YEARS)	LEVEL 1 – STANDARD ROW VEGETATION MANAGEMENT	LEVEL 2 – SELECTIVE ROW VEGETATION MANAGEMENT – WIRE-BORDER ZONE	LEVEL 3 – SELECTIVE ROW – CLEARANCE BASED VEGETATION MANAGEMENT
- Inland salt grass - Alkali sacaton					access roads). Operation Phase: Managed for retention of compatible vegetation.
Grassland/Steppe SO71, SO79, SO90 - Herbs and Shrubs	Herbs – 1 to 2 feet Shrubs – 1 to 5 feet	5 to 20 years	Construction Phase: Retained in ROW. Operation Phase: ROW managed for low growing shrubs and herbs.	NOT APPLICABLE	NOT APPLICABLE
Grassland – Invasive D08 - Cheatgrass - Red brome	Herbs – 1 to 2 feet	1 to 2 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for non-invasive low growing shrubs and herbs.	NOT APPLICABLE	NOT APPLICABLE
Riparian – Invasive D04 - Tamarisk	5 to 20 feet	5 to 20 years	Construction Phase: Cleared from ROW. Operation Phase: ROW managed for non-invasive low growing shrub species.	NOT APPLICABLE	NOT APPLICABLE

* Land cover types and dominant species listing is based on AECOM's Memorandum: Characteristics of Land Cover Crossed by TransWest Transmission Project Alternative Corridors, Draft, February 22, 2011.

Level 3 - Typical ROW Setting

Level 3 – ROW with Elevated Line Setting

FIGURE C-1 PHOTOGRAPHS OF LEVEL 3 VEGETATION MANAGEMENT

APPENDIX D

Supplemental Information - Technical Information of Applicability of Induced Current Risks for AC and DC Transmission Lines

APPLICABILITY OF INDUCED CURRENT RISKS FOR AC AND DC TRANSMISSION LINES

The proposed TWE Project ±600 kV DC transmission line presents no risk of inducing line currents due to the static nature of the DC electrical and magnetic fields. In comparison, AC transmission systems can induce currents. Mitigation measures for AC inductive currents would be implemented for the AC transmission lines associated with the Proposed TWE Project or for System Alternatives 2 and 3.

In order to mitigate possible electric shock caused by electrostatic and electromagnetic AC induction, all buildings, fences, and other structures with metal surfaces located within 300 feet of the centerline of the ROW will be grounded to the mutual satisfaction of the parties involved. Typically, residential buildings located 300 feet from the centerline will not require grounding. Other buildings or structures outside of the ROW will be reviewed in accordance with NESC to determine grounding requirements. All metal irrigation systems and fences that parallel the transmission line for distances of 500 feet or more, within 300 feet of the centerline will be grounded. All fences that cross under the transmission line also will need to be grounded. This procedure will be included in the construction specifications, and if grounding is required outside the ROW, agency and landowner consent will be obtained as necessary.

AC Inductive Mitigation for Railroads

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

These AC interference effects can be predicted with computer modeling. With proper planning and mitigation management, railroads and high voltage AC transmission lines can be safely collocated. The American Railway Engineering and Maintenance-of-Way Association has specifications for steady state rail-to-ground and equipment-to-ground voltage levels to ensure safety of railway operating personnel and the public. During fault conditions the safety criteria established by the ANSI/IEEE Standard 80 (Guide for Safety in AC Substation Grounding) is used. In addition, railroad signal and equipment manufacturers provide AC interference voltage tolerances for proper signal operation so that nearby transmission facilities can be designed to ensure that AC interference levels do not exceed the acceptable safety criteria or equipment voltage tolerance.

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

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

AC Inductive Mitigation for Pipelines

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

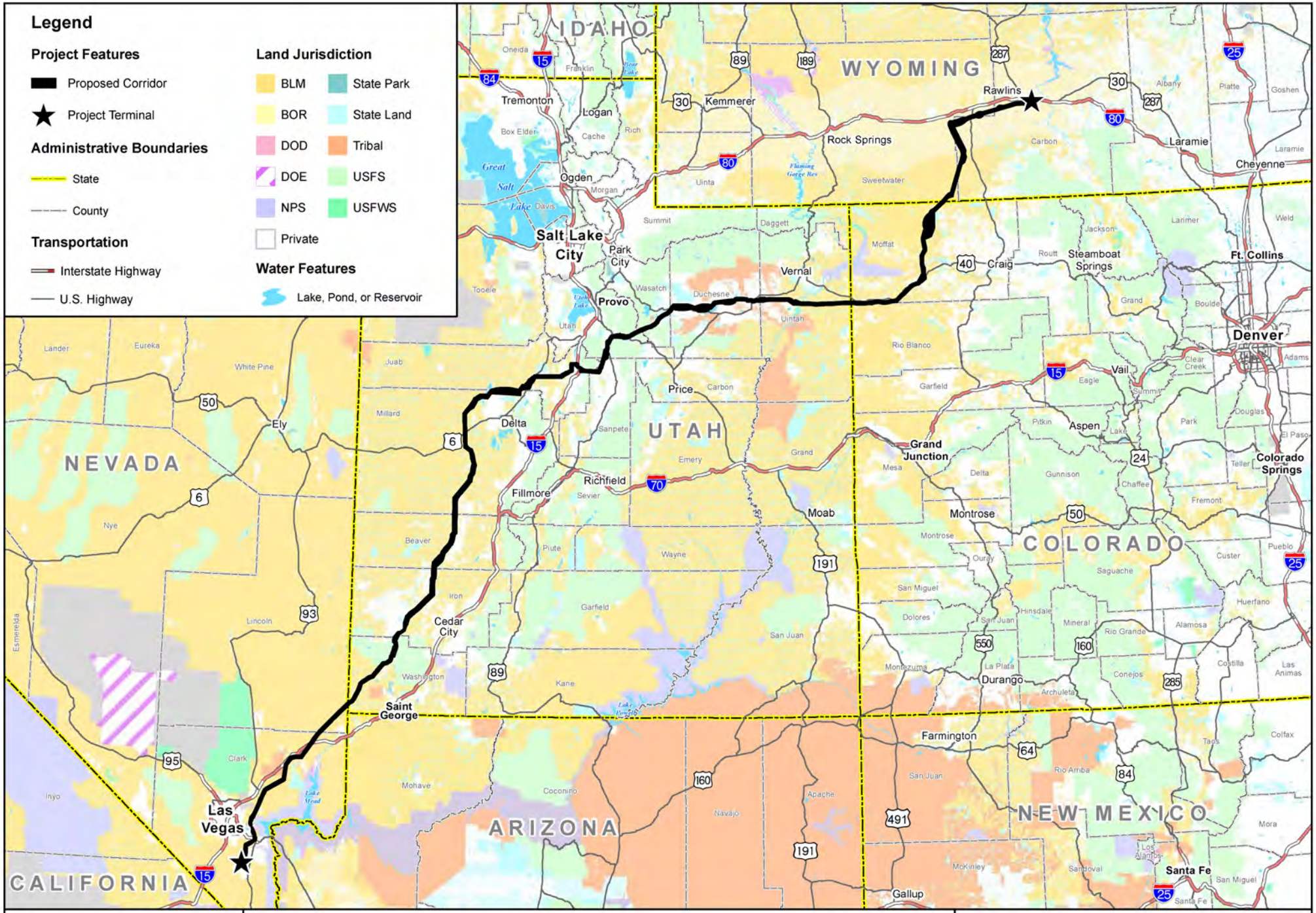
Conductive interference is a concern when a transmission line fault occurs in proximity to the pipeline, because it can cause AC currents to enter the pipeline at coating holidays (flaws in the coating) and produce a voltage gradient across the pipeline coating. Electric and magnetic effects are also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

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

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

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

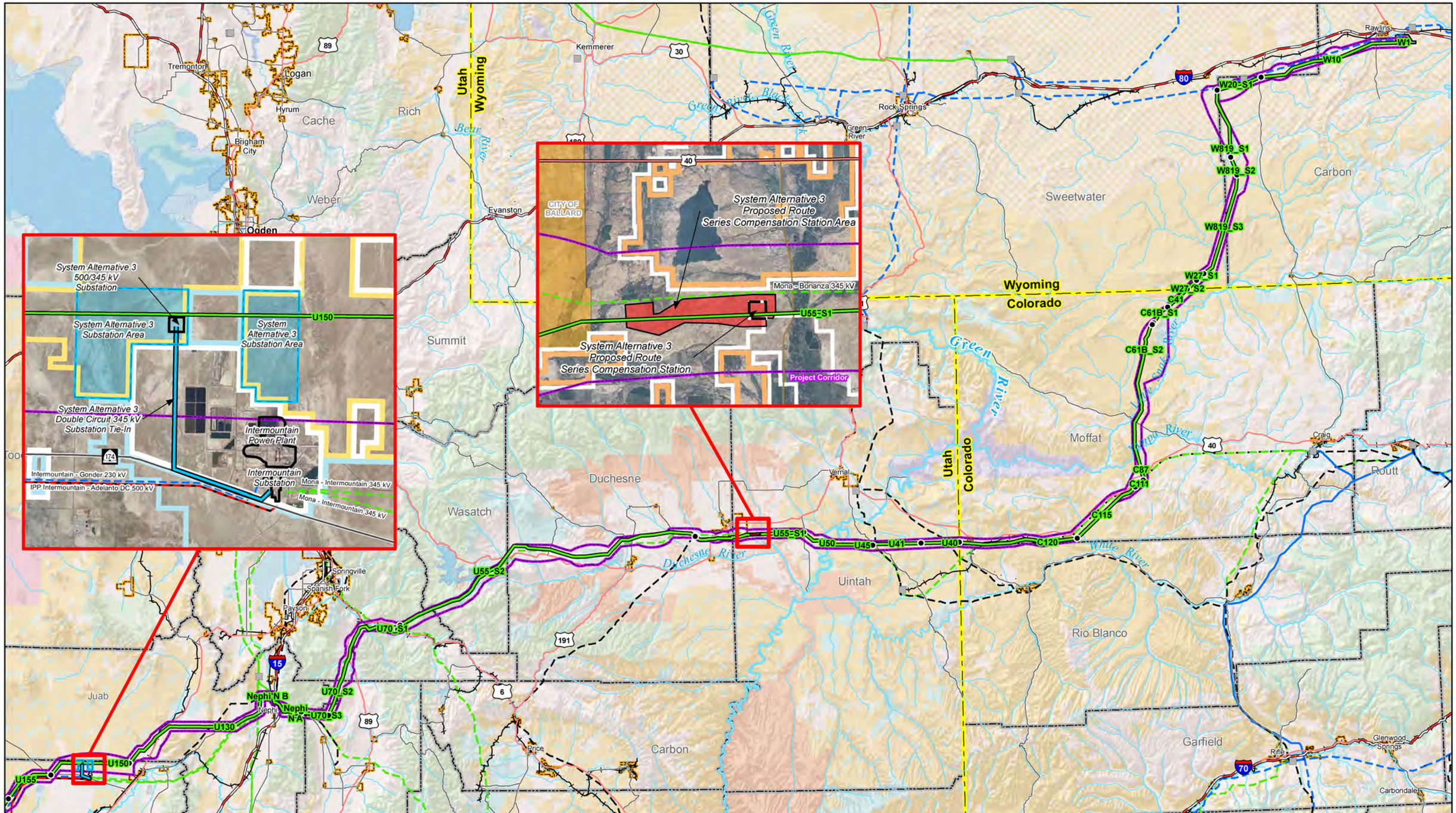
The TWE Project configured as an overhead AC transmission line can be located in its 250 foot ROW adjacent to the ROW for buried underground high pressure natural gas and other petroleum pipelines as long as proper grounding and cathodic protection systems are utilized for the pipeline. The TWE Project;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



Map Exhibit 1
Proposed Corridor, Regional Vicinity
TransWest Express Transmission Project | October 2012 | DRAFT

POWER ENGINEERS

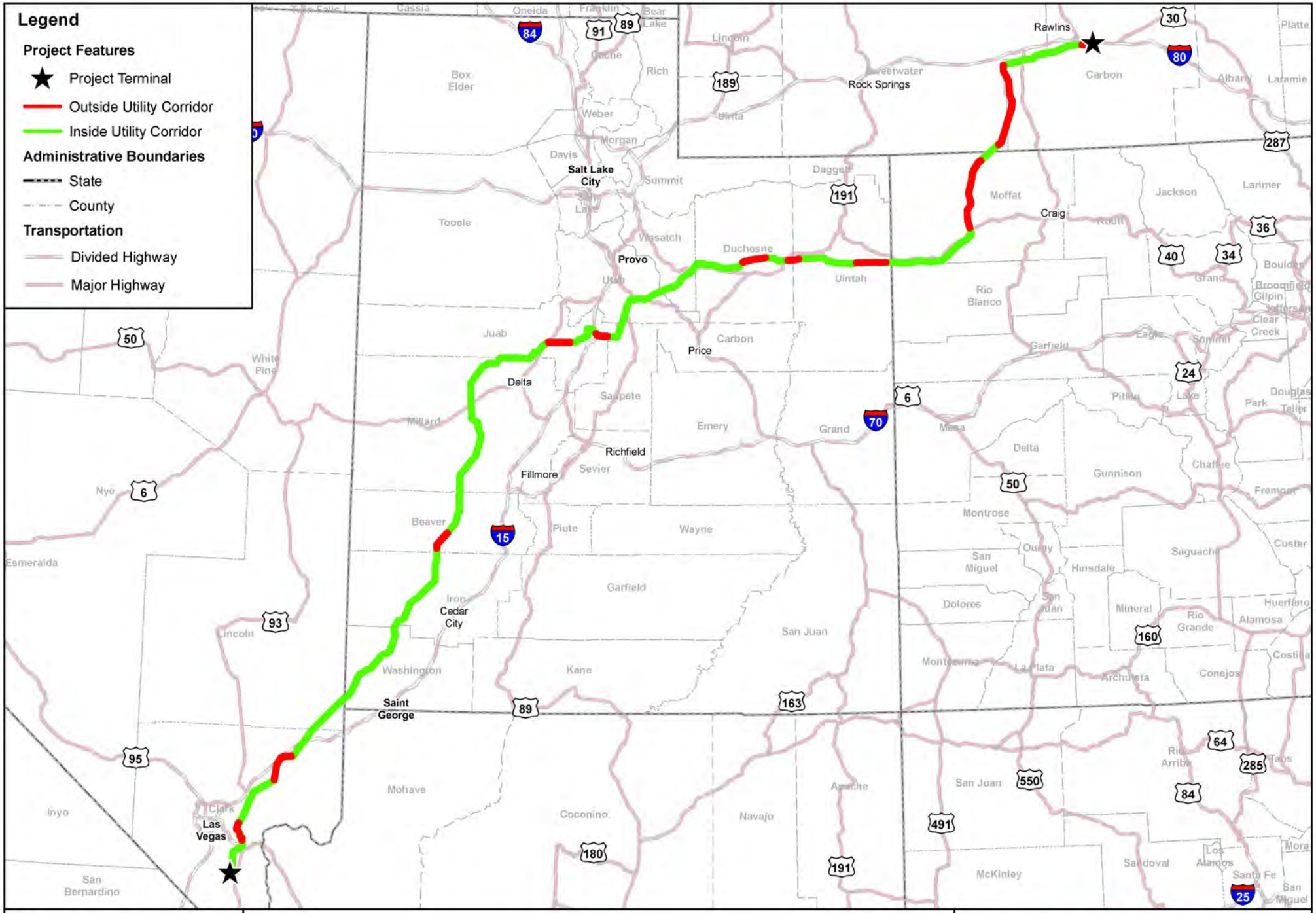
TRANSWEST EXPRESS LLC



TransWest Express Transmission Project
October 2012 Draft

Map Exhibit 10

System Alternative 3 Components



Map Exhibit 2
Proposed Route Utility Corridor Utilization
TransWest Express Transmission Project | October 2012 | DRAFT

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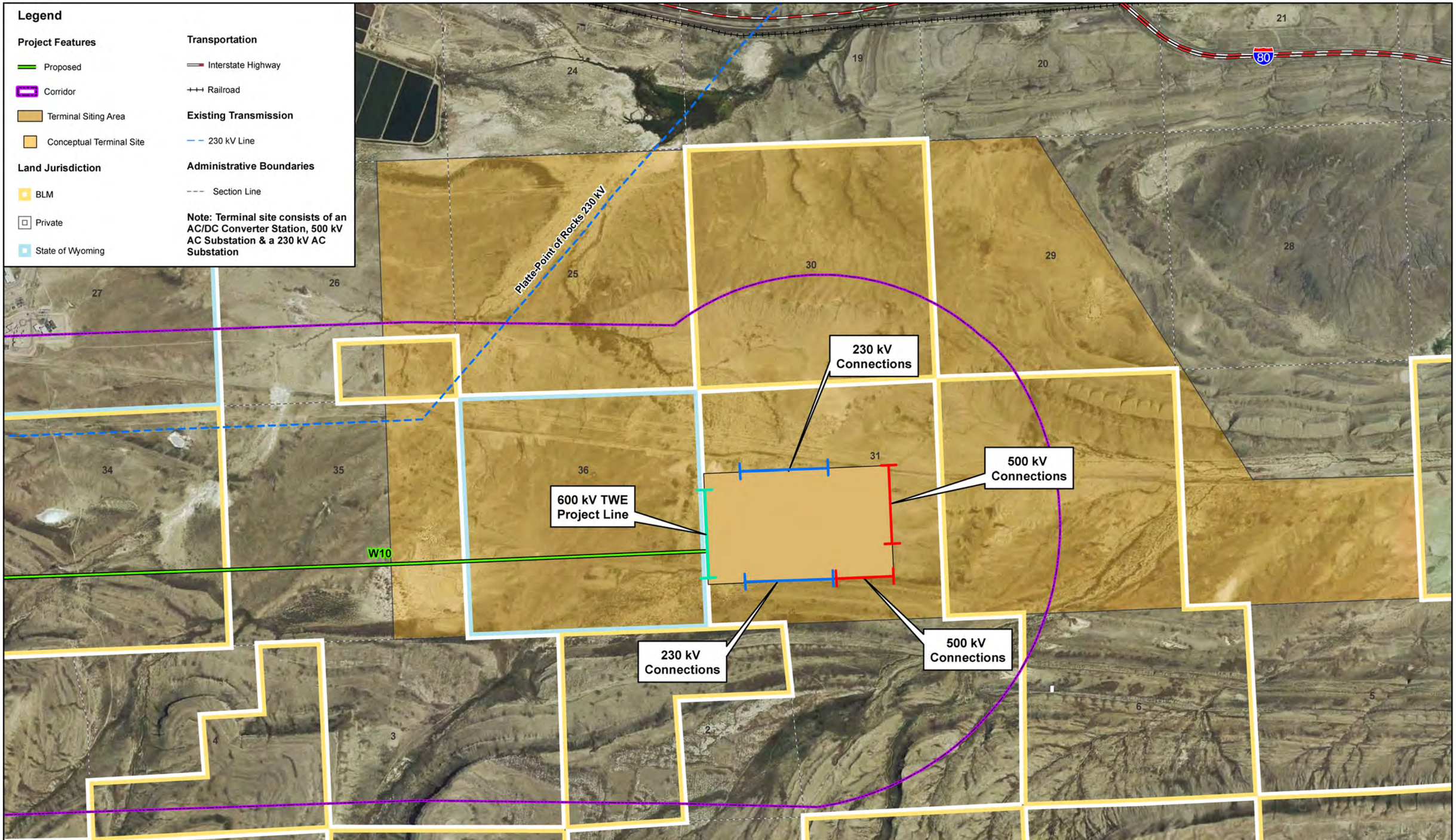
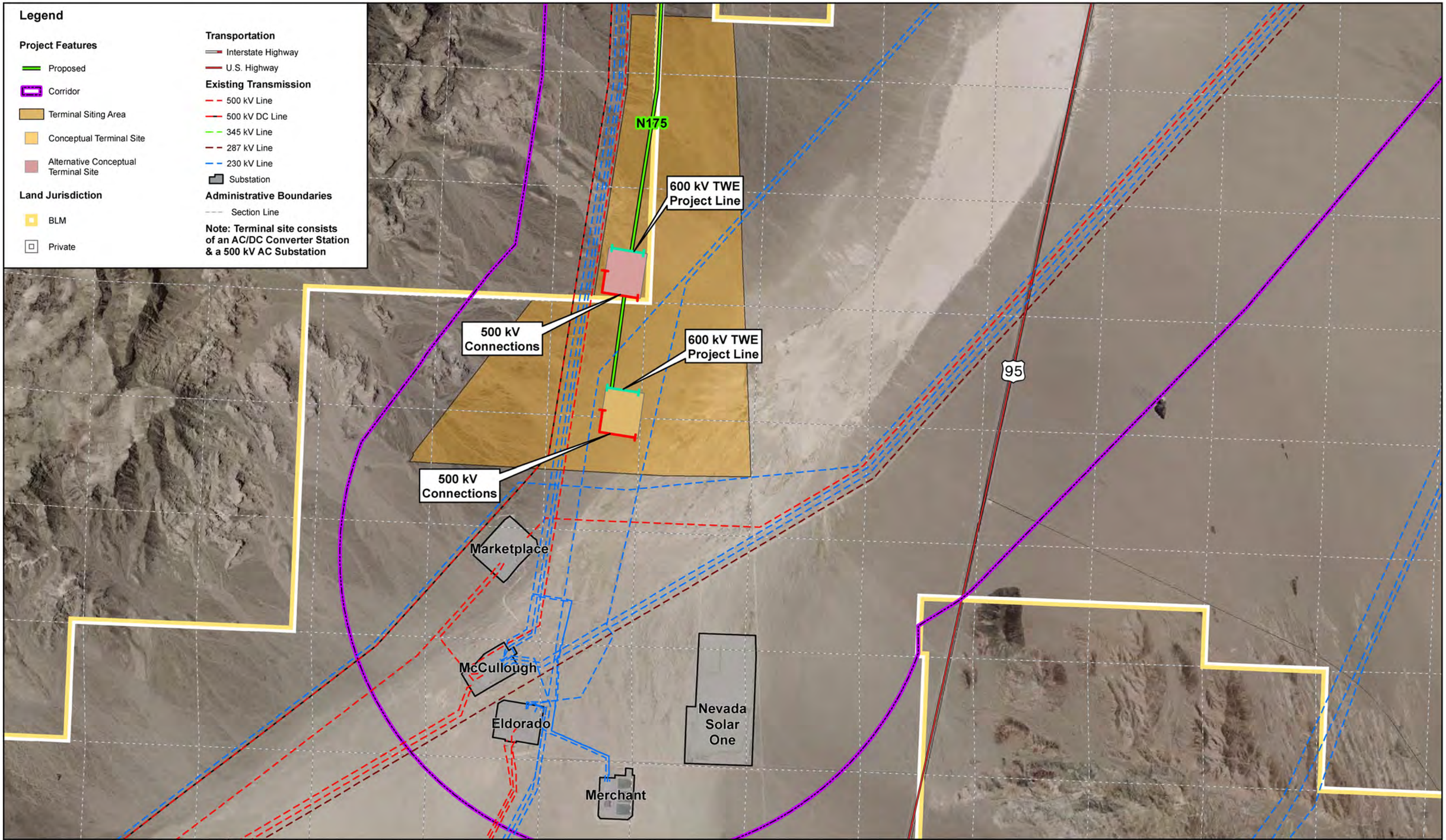


0 0.1 0.2 0.3 0.4 0.5
Miles

Map Exhibit 3
Conceptual Northern Terminal & Grid Interconnections
TransWest Express Transmission Project | October 2012 | DRAFT

POWER ENGINEERS
TRANSWEST EXPRESS LLC



Map Exhibit 4
Conceptual Southern Terminal & Grid Interconnections
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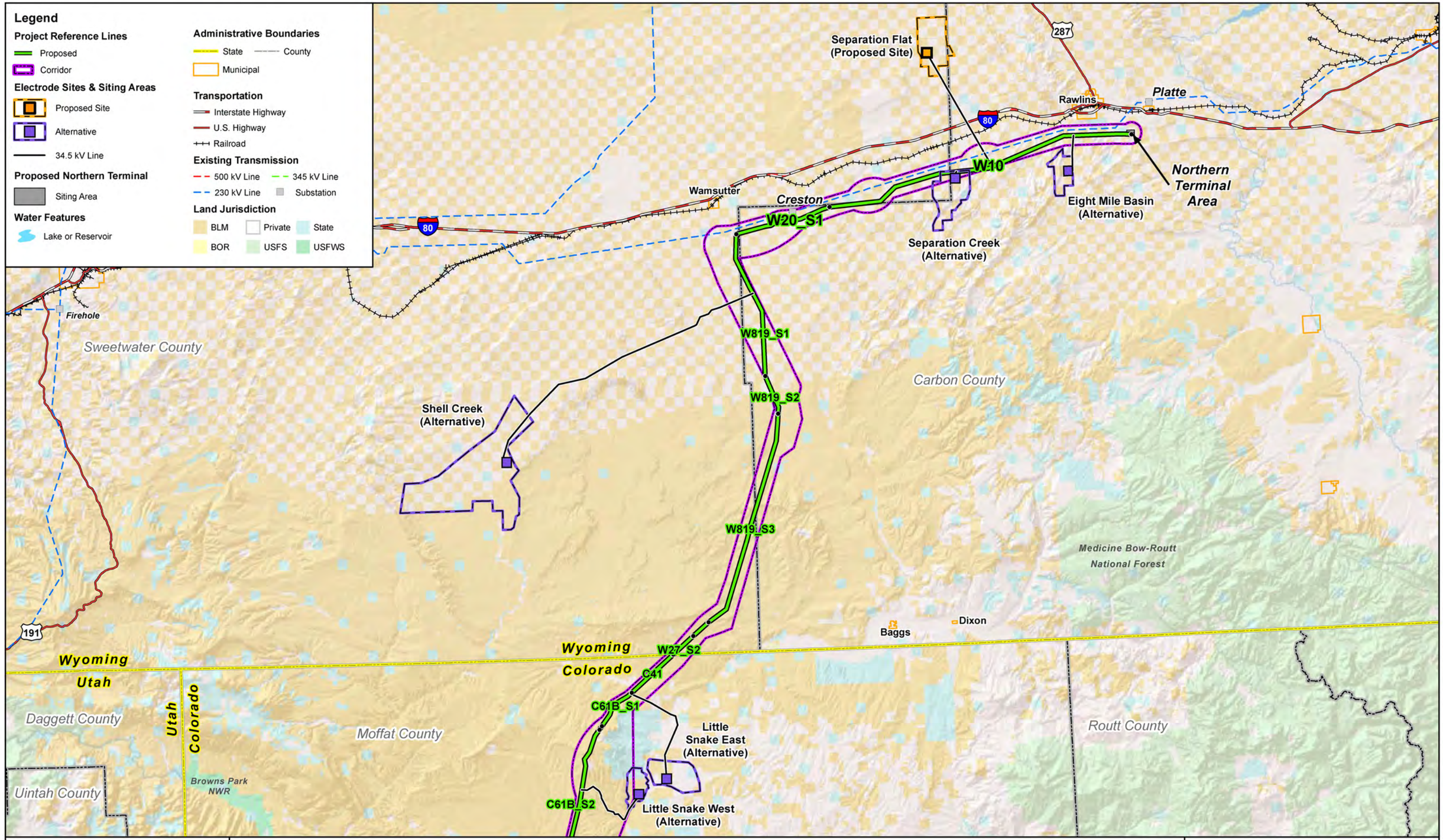
POWER ENGINEERS
TRANSWEST EXPRESS LLC



Map Exhibit 5

Northern Terminal and Ground Electrode System- Proposed and Alternative Sites and Siting Areas

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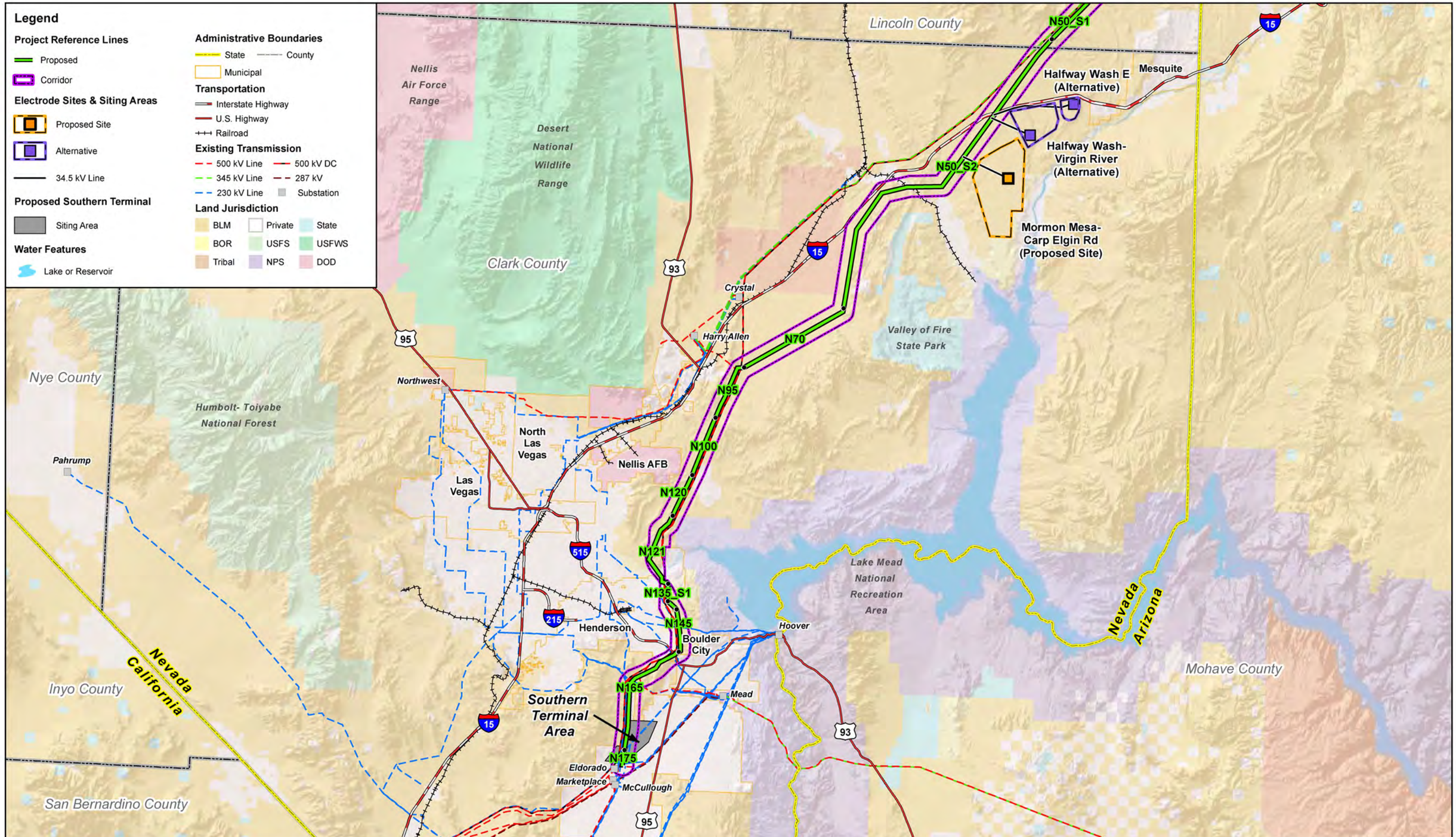

Map Exhibit 6

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

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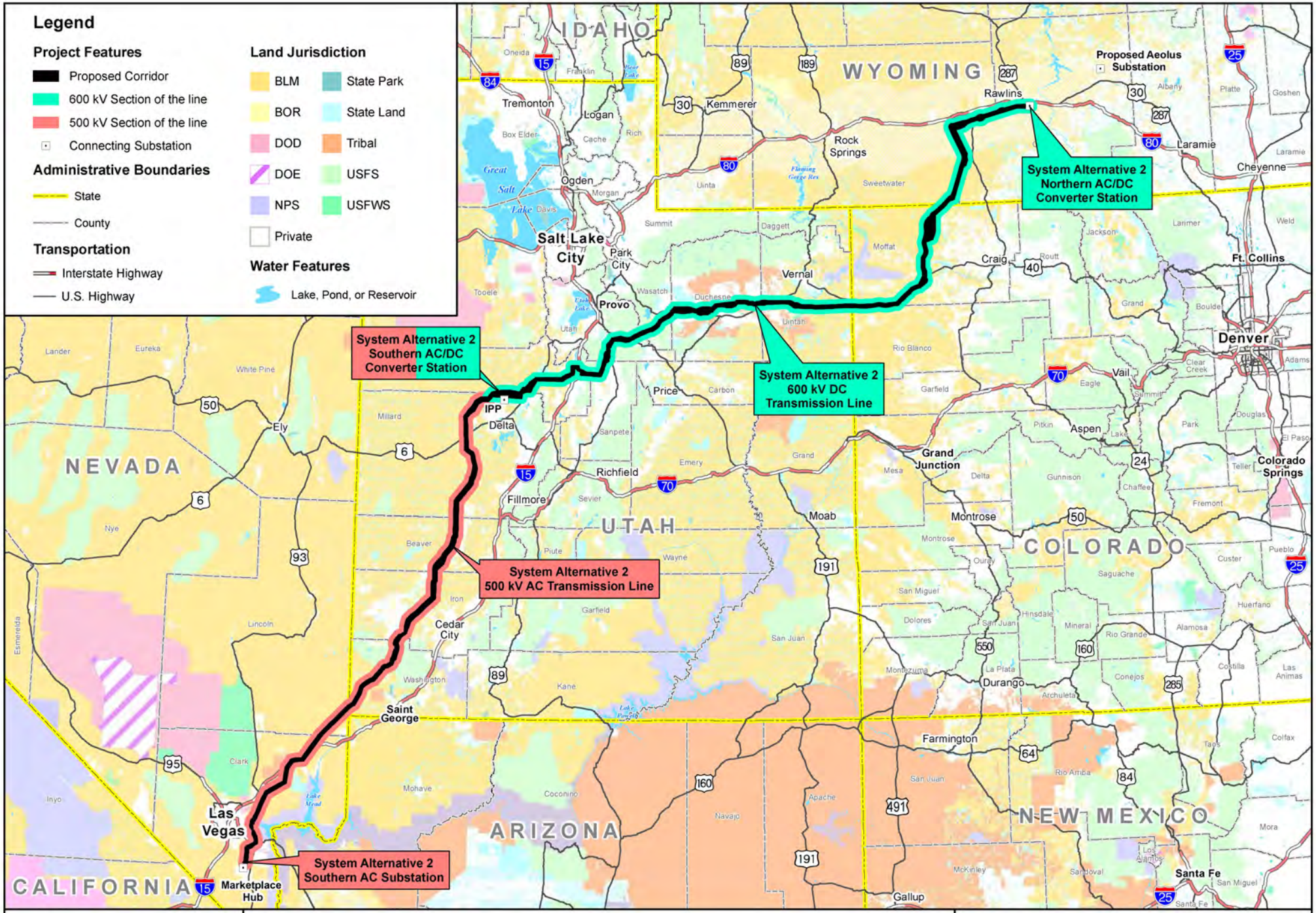

Map Exhibit 7

System Alternative 2: DC from Wyoming to IPP, AC from IPP to Marketplace Hub

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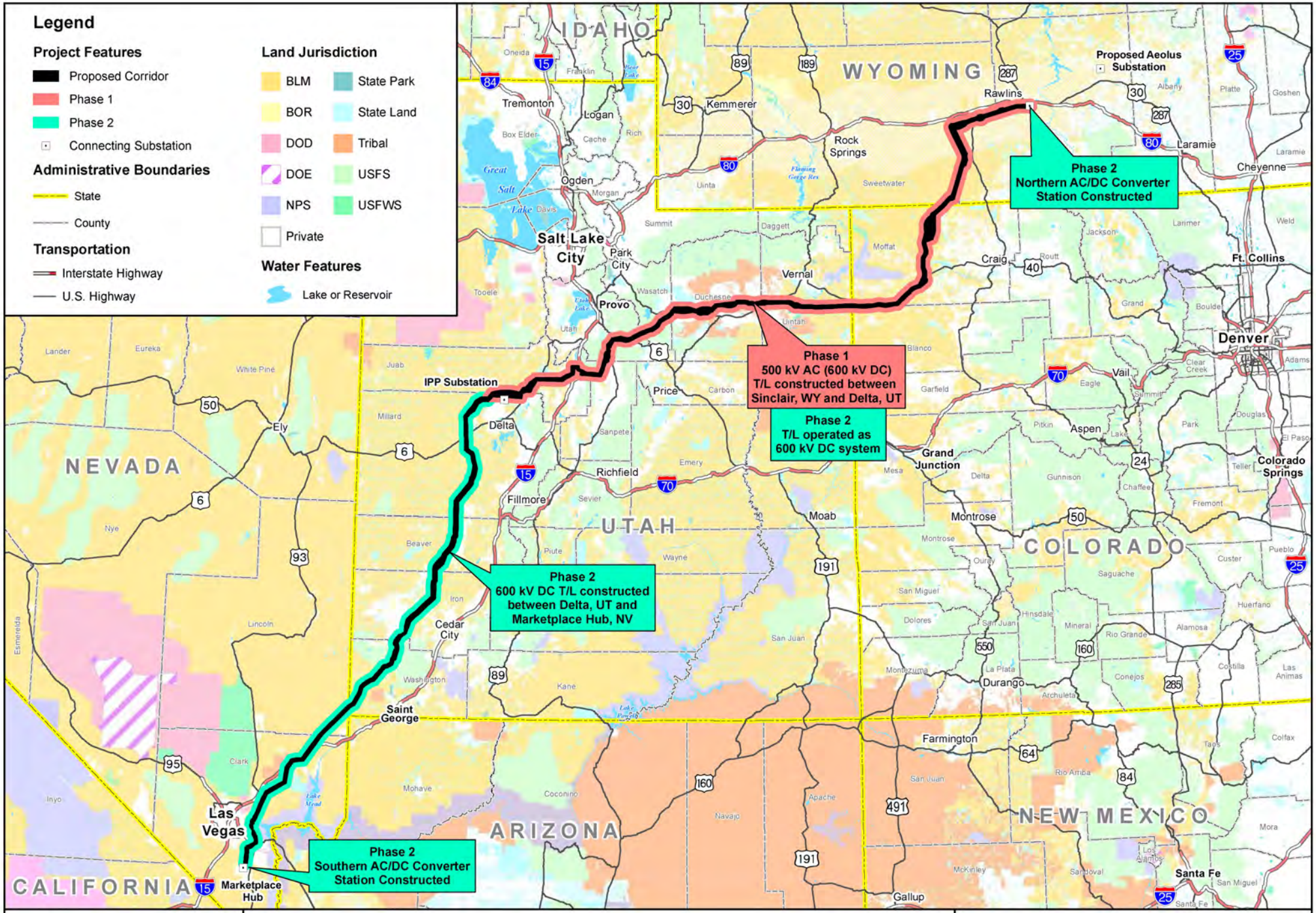
POWER ENGINEERS

TRANSWEST EXPRESS LLC



Map Exhibit 8
System Alternative 3: Phased Build-Out
TransWest Express Transmission Project | October 2012 | DRAFT

POWER ENGINEERS

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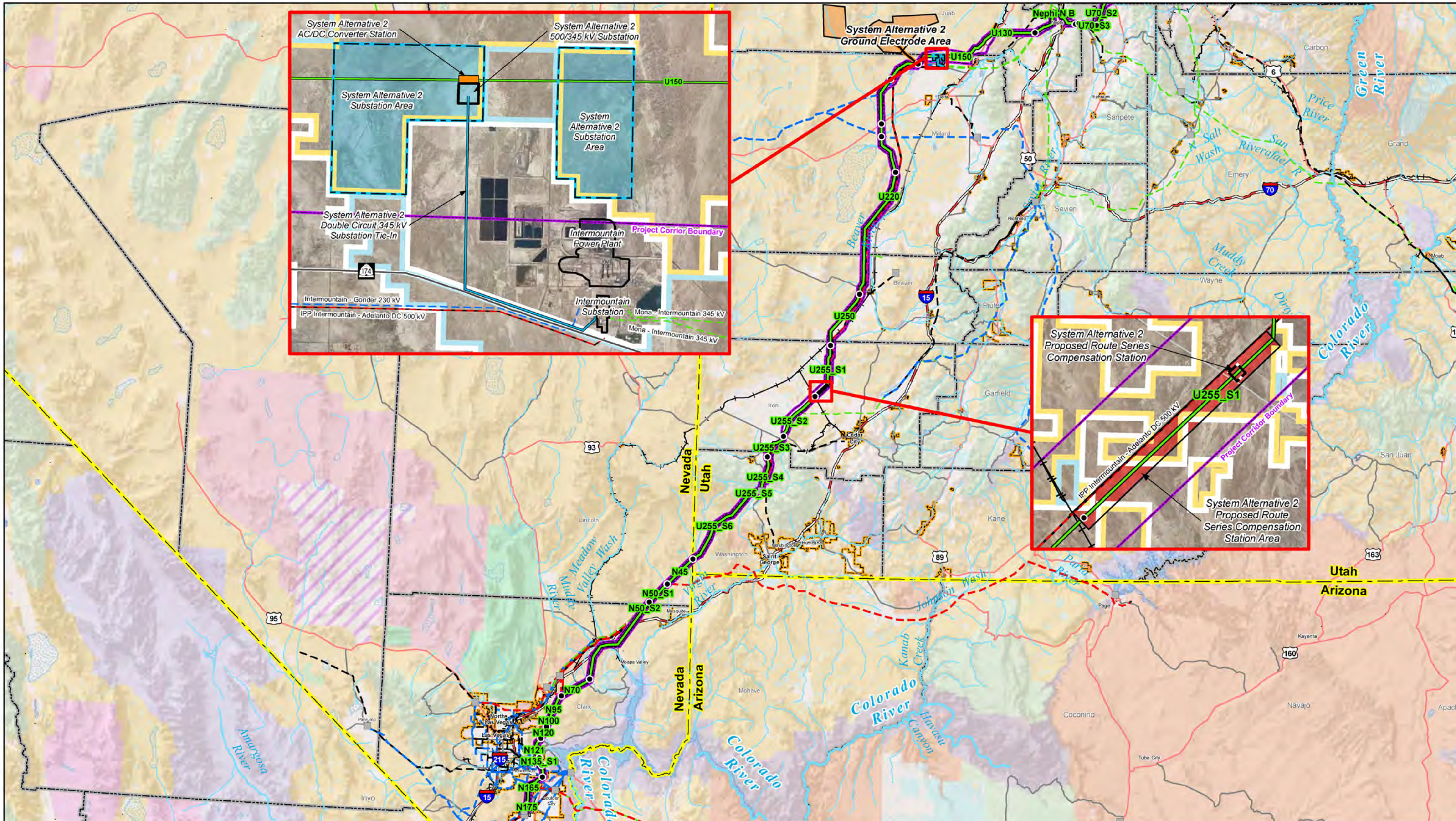

TransWest Express Transmission Project
October 2012 Draft

Map Exhibit 9

System Alternative 2 Components

Project Features
- Proposed Reference Line
- Route Segment Node
- Route Corridor
- Terminal Siting Area
- Ground Electrode Area
- Ground Electrode Site
- 34.5 kV Electrode Line

Administrative Boundaries
- Municipal Boundary

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

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

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