CONSULTANT REPORT

TRANSMISSION OPTIONS AND POTENTIAL CORRIDOR DESIGNATIONS IN SOUTHERN CALIFORNIA IN RESPONSE TO CLOSURE OF SAN ONOFRE NUCLEAR GENERATING STATION (SONGS)

ENVIRONMENTAL FEASIBILITY ANALYSIS

Prepared for: California Energy Commission

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ABSTRACT

This consultant report provides a high-level assessment of the environmental feasibility of a number of electric transmission alternatives under consideration by the California Independent System Operator in response to the closure of the San Onofre Nuclear Generating Station in June 2013. These alternatives may be considered by California Energy Commission staff for potential electric transmission corridor designation. While the alternatives examined may provide electrical solutions for addressing challenges arising from the closure of the San Onofre Nuclear Generating Station, this report presents and examines the likely siting constraints that may have to be considered during the environmental permitting process for each potential alternative.

Both alternating current and direct current corridor alternatives were examined, along with several potential submarine high-voltage direct current alternatives.

The alternatives were ranked on a qualitative four-step scale that ranges from possible, possible but challenging, challenging, to very challenging.

Keywords: California Energy Commission, San Onofre Nuclear Generating Station, environmental assessment, electrical transmission, onshore transmission alternatives, offshore transmission alternatives, siting constraints, AC, HVDC, submarine HVDC technology

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EXECUTIVE SUMMARY

Introduction

Aspen Environmental Group prepared this feasibility analysis in response to a request from the California Energy Commission staff to inform the Energy Commission staff and California Independent System Operator about environmental feasibility concerns related to potential electric transmission options under consideration by the California Independent System Operator in response to the closure of the San Onofre Nuclear Generating Station. These options may be considered by the Energy Commission staff for potential transmission corridor designations.

Under the direction of the Energy Commission staff, Aspen worked with an external team that included representatives of Southern California utilities in the study area (San Diego Gas & Electric Company [SDG&E] and Southern California Edison [SCE]); state and federal agencies with permitting authority in the study area (U.S. Bureau of Land Management, U.S. Forest Service, California Public Utilities Commission, California State Parks, and the San Diego County Planning Department) and the California ISO.

The group held an initial WebEx meeting to introduce and discuss the work, and several follow-up meetings with subsets of this external team were held to gather more specific input. This report is the result of Aspen's assessment of the information gathered throughout this process under the direction of the Energy Commission staff.

Purpose

Aspen studied potential corridors for two basic types of transmission options. First, the report describes and evaluates a series of potential onshore transmission alternatives, including both alternating current (AC) and direct current (DC) systems and substation upgrades. Second, the report describes and evaluates the technology, viability, and potential to develop offshore corridors for a high-voltage direct current (HVDC) submarine cable between the SCE and SDG&E territories. The studied alternatives include:

- Alternative 1, Submarine HVDC Cable.
- Alternative 2, Alberhill to Suncrest.
- Alternative 3, Enhanced Talega-Escondido/Valley-Serrano (Forest Route).
- Alternative 4, Enhanced Talega-Escondido/Valley-Serrano (Talega-Serrano Route).
- Alternative 5, Imperial Valley to Inland (Overhead AC and Overhead/Underground DC).
- Alternative 6, Valley to Inland (Overhead AC or Underground DC).
- Alternative 7, Imperial Valley Expansion.

- Alternative 8, Mesa Substation Loop-In.

Conclusions

This work presents an early-stage evaluation of the potential transmission corridors in the Southern California study area. Developing any of the transmission options would require viable project sponsors with experience and access to sufficient resources to establish an optimum route and design. The considerations identified here provide an overview of requirements stemming from regulatory agency oversight, environmental issues, and technical or construction engineering concerns. Comprehensive environmental and technical studies would still need to occur before any agency could approve a project within any of the corridors.

Table ES-1 is the key to the colors used in the summary table of transmission alternatives and major constraints. Table ES-2 (Transmission Alternatives – Descriptions and Major Constraints) summarizes the results of this study. This analysis finds that permitting the submarine cable HVDC and five of the onshore transmission alternatives would be possible but challenging. Furthermore, the Mesa Substation Loop-In alternative could be implemented in a shorter time frame than the other onshore transmission alternatives.

Table ES-1 Key to Summary Table: Likelihood of Successful Permitting and Construction

■ **Green**: Possible	No major obstacles to permitting or construction
■ **Yellow**: Possible but Challenging	Siting constraints but likely can be overcome
■ **Orange**: Challenging	Serious siting challenges that may not be resolvable
■ **Red**: Very Challenging	Very serious siting challenges that may make routes infeasible

Source: Aspen Environmental, 2014.

Table ES-2: Transmission Alternatives – Descriptions and Major Constraints

Alternative Name	Description	Constraints	Likelihood of Successful Permitting
Alternative 1. Submarine Cable HVDC	Alamitos or Huntington Beach, to San Onofre or Encina	• Steep seafloor slopes and canyon crossings • High risk of seafloor instability, seismic ground movement, and fault rupture • Securing the cable to the seafloor would impact to benthic habitat, hard-bottom areas, rocky substrate, or bedrock • Laguna Beach marine conservation areas • Huntington Beach State Park	**Possible but Challenging**
Alternative 2. Alberhill to Suncrest	500 kV Alberhill to Suncrest I-15 Corridor to SR 79	<u>Alberhill to Inland (Riverside County)</u> • Dense development in Temecula • Longitudinal encroachment in Caltrans I-15 ROW <u>Inland to Suncrest</u> • Cleveland National Forest to Suncrest proposed wilderness designation • Scenic, low-density areas in northern San Diego Co. • Small airport near Warner Springs	**Very Challenging**

Table ES-2: Transmission Alternatives – Descriptions and Major Constraints

Alternative Name	Description	Constraints	Likelihood of Successful Permitting
Alternative 3. Enhanced Talega-Escondido/ Valley – Serrano (TE/VS) (Forest Route)	500kV Alberhill to Inland	• Expansion of Talega Substation • TE/VS through Cleveland National Forest, Trabuco Ranger District • Expansion of ROW through Santa Margarita Ecological Reserve • Expansion of ROW through Camp Pendleton	**Challenging**
	500 kV Inland to Suncrest	• ROW across La Jolla Reservation • Cleveland National Forest to Suncrest proposed wilderness designation • Scenic, low-density areas in northern San Diego Co.	**Very Challenging**
Alternative 4. Enhanced Talega-Escondido/ Valley – Serrano (TE/VS) (Talega-Serrano Route)	500 kV Serrano to Inland	• Expansion of facilities through residential area in Mission Viejo and other communities • Expansion of Talega Substation • Expanded ROW into Talega Substation • Expansion of ROW through Santa Margarita Ecological Reserve • Expansion of ROW through Camp Pendleton	**Challenging**
	500 kV Inland to Suncrest	• ROW across La Jolla Reservation • Cleveland National Forest to Suncrest proposed wilderness designation • Scenic, low-density areas in northern San Diego Co.	**Very Challenging**

Table ES-2: Transmission Alternatives – Descriptions and Major Constraints

Alternative Name	Description	Constraints	Likelihood of Successful Permitting
Alternative 5, 1A. Imperial Valley to Inland 500 kV Overhead	Overhead 500 kV Imperial Valley Sub to eastern boundary of Anza-Borrego Desert State Park (ABDSP)	• Overhead construction across BLM land and private agricultural land • Special status species mitigation required; loss of productive agricultural land	**Possible but Challenging**
	Overhead 500 kV through Anza-Borrego Desert State Park (ABDSP)	<u>Anza-Borrego Desert State Park:</u> • Overhead construction in Anza-Borrego Desert State Park • Inadequate ROW through ABDSP Wilderness • Angelina Springs Cultural Reserve <u>Santa Rosa-San Jacinto National Monument Option:</u> • Monument; National Forest Roadless Areas; Santa Rosa Reservation; ABDSP Wilderness	**Very Challenging**
	Overhead 500 kV west of ABDSP	<u>Northern San Diego County:</u> • ROW across La Jolla Reservation • Scenic, low-density areas in northern San Diego Co.	**Very Challenging**

Table ES-2: Transmission Alternatives – Descriptions and Major Constraints			
Alternative Name	**Description**	**Constraints**	**Likelihood of Successful Permitting**
Alternative 5, 1B. Imperial Valley to Inland HVDC Overhead and Underground	Overhead HVDC Imperial Valley Sub to eastern boundary of ABDSP	• Overhead construction across BLM land and private agricultural land.	**Possible but Challenging**
	Underground HVDC through ABDSP	• Construction disturbance and traffic in ABDSP • Disturbance of bighorn sheep and seasonal construction constraints • Construction challenges (bedrock and Earthquake Valley Fault)	**Challenging**
	Overhead **or** underground west of ABDSP	• ROW across La Jolla Reservation • Scenic, low-density areas in northern SD Co.	**Challenging**
Alternative 6, 2A. Valley to Inland 500 kV Overhead	All Overhead 500 kV Through Temecula and environs	• Must avoid Pechanga Reservation and Agua Tibia Wilderness • Dense development in Temecula • Southwestern Riverside County Multispecies Core Reserve • Temecula Bike Path	**Very Challenging**
Alternative 6, 2B. Valley to Inland HVDC All Underground	All underground DC Through Temecula and environs	• Existing buried utilities in road ROW • Engineering considerations in design	**Possible but Challenging**

Table ES-2: Transmission Alternatives – Descriptions and Major Constraints

Alternative Name	Description	Constraints	Likelihood of Successful Permitting
Alternative 7. Imperial Valley Sub. Expansion	Expand Imperial Valley Substation	• Flat-tailed horned lizard habitat • BLM Yuha Desert Wildlife Management Area	**Possible but Challenging**
Alternative 8. Mesa Substation Loop-In	Expand SCE Mesa Substation	• SCE states that expansion is possible	**Possible**

Source: Aspen Environmental, 2014.

CHAPTER 1:
Opportunities and Constraints for Onshore Transmission Siting in Study Area

This chapter describes the opportunities and constraints related to the onshore alternatives being considered in this report. The section "Previous Studies" summarizes the previous major studies that considered transmission routes in the study area. The section "Opportunities for Transmission Siting" describes the opportunities for transmission siting in the study area, and the section "Constraints for Transmission Siting in Study Area" describes the constraints and challenges that exist in this region. The section "Regulatory Requirements for Potential Land Based Transmission" is a summary of the existing regulations that govern transmission line siting.

Previous Studies

The onshore transmission alternatives studied are located in Imperial, San Diego, Riverside, and Orange Counties. Two major studies of high voltage transmission lines have been published by the California Public Utilities Commission (CPUC) in the past 13 years: first for the San Diego Gas & Electric Company (SDG&E) proposed Valley-Rainbow project and second for the SDG&E Sunrise Powerlink project. Each study is summarized below.

Valley-Rainbow

On March 23, 2001, SDG&E proposed to construct an approximately 30-mile-long, 500 kilovolt (kV) transmission line that would connect the Southern California Edison Company (SCE) Valley Substation (in southern Riverside County) with the proposed Rainbow Substation in northern San Diego County. In addition, the proposed project included a second 230 kV circuit to the Talega-Escondido transmission line and modifications of several SDG&E substations.

The CPUC's assigned administrative law judge determined that alternatives to the proposed project be evaluated before initiating the California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) process. Therefore, in November 2002, the CPUC published the *SDG&E Valley Rainbow 500 kV Interconnect Project, Interim Preliminary Report on Alternatives Screening*. This comprehensive report identified and evaluated about 45 alternatives. The alternatives are illustrated on Figure 1 on page 22; they were divided into the following categories:

- New 500 kV transmission alternatives between the Valley and proposed Rainbow Substation, or existing Pala Substation.

- New 500 kV route through the Cleveland National Forest (CNF) Trabuco or Palomar Districts.

- New 500 kV transmission alternatives connecting other SDG&E substations in Orange and Riverside Counties and Imperial Irrigation District substations in Imperial and San Diego Counties.

- 500 kV transmission alternatives that would use or parallel existing utility rights-of-way in Orange, Riverside, Imperial, and San Diego Counties.

- Alternative transmission system designs, voltages, and nonwires alternatives.

Ultimately, SDG&E withdrew its application to the CPUC, and no environmental impact report (EIR)/environmental impact statement (EIS) was prepared.

As part of the CPUC's assessment of Valley-Rainbow alternatives, an engineering study was prepared to consider the transmission line corridor between the SDG&E Talega and the SCE Serrano Substations (Commonwealth, 2002). This report evaluated design options in several segments of the Talega-Serrano corridor, and concluded that the installation of a new 500 kV line on the existing rights-of-way (ROWs) from Serrano to Talega would be feasible, but that it would require substantial reconfiguration of the existing lines in the corridor, including installing one line underground.

Sunrise Powerlink

The route originally proposed by SDG&E is shown in Figure 2 on page 23; it included an overhead segment passing through Anza-Borrego Desert State Park (ABDSP) that was highly controversial. The alternative that was ultimately approved and constructed was one of the Southern Route alternatives, illustrated in Figure 3 on page 24. The final route avoided ABDSP but did pass through portions of the Cleveland National Forest.

Proposed Route and Approved Route

The route originally proposed by SDG&E is shown in Figure 2; it included an overhead segment passing through ABDSP that was highly controversial. The alternative that was ultimately approved and constructed was one of the Southern Route alternatives, illustrated in Figure 3. The final route avoided ABDSP but did pass through portions of the Cleveland National Forest.

Alternatives Studied

The EIR/EIS evaluating the proposed Sunrise Powerlink project included a broad analysis of alternatives, covering the same geographic range as the alternatives studied for the Valley-Rainbow analysis. The Sunrise alternatives screening process culminated in the identification and preliminary screening of more than 100 potential alternatives. These alternatives range from minor routing adjustments to SDG&E's proposed project location, to entirely different transmission line routes, to alternative energy technologies, as well as nonwire alternatives. Figure 3 illustrates the alternatives evaluated.

Opportunities for Transmission Siting

In seeking routes for new overhead transmission lines, the primary opportunity for lower impact routes is an existing transmission corridor. The Garamendi Principles are encouraged for transmission siting. As described in the California Energy Commission's *Energy Aware Facility Permitting and Siting Guide* (California Energy Commission, 2010), a new law was passed to recognize the value of the transmission system and need for effective long-term transmission corridor planning (Senate Bill 2431, Garamendi, Chapter 1457, Statutes of 1988). The law declared that it is in the best interests of the state to:

- Encourage the use of existing ROWs by upgrading existing transmission facilities where technically and economically justifiable.
- When construction of new transmission lines is required, encourage expansion of existing rights-of-way, when technically and economically feasible.
- Provide for the creation of new ROWs when justified by environmental, technical, or economic reasons, as determined by the appropriate licensing agency.
- Where there is a need to construct additional transmission, seek agreement among all interested utilities on the efficient use of that capacity.

However, in densely populated areas like Southern California, residential development is often located immediately adjacent to existing corridors, so the proposed use of these corridors for more and higher voltage lines can result in strong and organized opposition to proposed projects. Examples of this opposition have occurred in:

- Sunrise Powerlink. The proposed coastal segment would have required installation of new towers in an existing ROW with adequate existing space for new towers. Numerous neighbors submitted comments stating that they already bore the impacts of an existing corridor and that it was unfair to increase that burden.
- Tehachapi Renewable Transmission Project (TRTP), Chino Hills segment. SCE proposed installation of single- or double-circuit 500 kV towers in an existing ROW previously occupied by a 220 kV line. The CPUC initially approved a double-circuit overhead 500 kV line, and SCE began installation of the towers. After intense and persistent opposition, the CPUC later reconsidered its approval and ordered SCE to install the line underground, as well as to remove the newly constructed towers.

Constraints for Transmission Siting in Study Area

The Valley-Rainbow and Sunrise Powerlink alternative studies document the substantial geographic and land-use constraints associated with attempts to design a successful transmission line route through the region. Figure 4 on page 25 presents an overview of land uses in the study area, including the land uses that are most challenging for transmission line siting. The most significant constraints are described below.

Anza-Borrego Desert State Park

Anza-Borrego Desert State Park extends from only 3 miles north of the Mexican border roughly 65 miles north to its northern border at the Santa Rosa-San Jacinto National Monument. Given the north-south extent of the park, there are three potentially feasible ways of routing a 500 kV transmission line from Imperial County into San Diego and Riverside Counties, unless considering a transmission line route as far north as the Interstate 10 (I-10) corridor (Devers Substation and west). Figure 5 on page 26 illustrates these locations. Each is described as follows:

South of the Park

The existing Southwest Powerlink (SWPL) and Sunrise Powerlink 500 kV lines now pass south of the ABDSP boundary.

Through the Park, Grapevine Canyon/Highway 78

In 2005, SDG&E proposed the 500 kV Sunrise Powerlink to pass through the center of the park, following an existing Imperial Irrigation District (IID) and SDG&E 92/69 kV line along State Route (SR) 78, then through Grapevine Canyon. The feasibility of the proposed installation of a 500 kV line through the park was questionable due to the narrow width of the existing ROW (which runs between designated Wilderness Areas). In addition, in 2012, the park designated a portion of Grapevine Canyon (through which the existing 69 kV line passes) as a "cultural preserve," which would almost certainly prohibit future consideration of another transmission line through Grapevine Canyon. The remaining option through this part of the park is underground in SR 78, an alternative considered in the Sunrise Powerlink EIR/EIS and discussed further in Alternative 5 (in Chapter 2).

Immediately North of the Park, Highway 74

This route would generally follow the "Pines to Palms Highway" (designated as a National Scenic Byway by the San Bernardino National Forest [SBNF]) and an "eligible" scenic highway by the California Department of Transportation (Caltrans). An overhead transmission line route through this area would require passing through about 15 miles of the Santa Rosa-San Jacinto National Monument, which includes portions of the SBNF. There are several major constraints in this area, as illustrated on Figure 6 on page 27:

- A portion of the area immediately north of ABDSP is designated as "Cactus Springs-B Inventoried Roadless Area;" however, the U.S. Forest Service (USFS) is in the process of redesignating this land with a proposed use of "Backcountry Non-Motorized." This new designation would prohibit utility use.
- Immediately west of the SBNF is the Santa Rosa Indian reservation.
- Immediately south of the reservation is ABDSP designated wilderness.

Based on these constraints, it appears that the remaining route through the area may be to install an HVDC line underground within Highway 74. This route would be feasible only in the following circumstances:

- If the USFS and the U.S. Bureau of Land Management (BLM) allow an overhead high-voltage direct current (HVDC) transmission line within the National Monument boundaries (but outside wilderness and roadless areas).
- If the HVDC line can be installed underground starting just east of the roadless areas and ending at the western boundary of the Santa Rosa Indian reservation.

Santa Rosa -San Jacinto National Monument

The Santa Rosa-San Jacinto National Monument was designated by Congress in Public Law 106-351 in October 2000. Within its boundaries are BLM land, USFS land (within the SBNF), and private land. It was designated " … in order to preserve the nationally significant biological, cultural, recreational, geological, educational, and scientific values found in the Santa Rosa and San Jacinto Mountains and to secure now and for future generations the opportunity to experience and enjoy the magnificent vistas, wildlife, land forms, and natural and cultural resources in these mountains and to recreate therein." The BLM approved the Management Plan for the Monument in 2004 (BLM, 2004).

The monument's location and its boundaries are illustrated in Figure 6 on page 27. The Pacific Crest Scenic Trail also passes through the monument. The BLM describes the monument as follows:

> The National Monument's boundary encompasses about 272,000 acres, including 65,000 acres within the San Jacinto Ranger District of the San Bernardino National Forest, and 89,500 acres within the Bureau of Land Management's California Desert Conservation Area. The National Monument includes two federal Wilderness Areas: the Santa Rosa Wilderness which contains 61,600 acres of BLM and Forest Service lands, and 19,470 acres of the Forest Service's San Jacinto Wilderness. Its boundary also surrounds lands owned and administered by the Agua Caliente Band of Cahuilla Indians, California Department of Parks and Recreation, California Department of Fish and Game, other agencies of the State of California, and private landowners.

The management plan is silent on utility use (but defers to BLM or USFS land-use restrictions, as appropriate), but Public Law 106-351 addressed potential use of Monument lands for utilities as follows:

> (e) UTILITIES.— […] The management plan prepared for the National Monument shall address the need for and, as necessary, establish plans for the installation, construction, and maintenance of public utility rights-of-way within the National Monument outside of designated wilderness areas.

There has not yet been a proposal to construct a transmission line through the monument, but given its purpose and scenic value, such a proposal would likely be met with vocal opposition.

National Forest Lands

San Diego and Riverside Counties include large areas of National Forest System lands, including portions of the CNF and the SBNF. Figure 4 (overview map on page 25) illustrates the locations of these dispersed Forest Service units. USFS lands can be challenging for siting major

transmission lines because the lands are protected with a variety of land-use categories, many of which are restrictive as to development of utilities.

For this study, there are three USFS areas of most concern: the CNF Boulder Creek area between the Suncrest Substation and the town of Santa Ysabel, the CNF area around Mount Palomar (Highway 79 on the north and Highway 76 on the south), and the SBNF area between Temecula and the Coachella Valley (following Highway 74). Constraints for each area are described briefly below.

1. **CNF Boulder Creek Area** (Alternative 2, Alberhill to Suncrest, and Alternatives 3 and 4, Enhanced Tallega-Escondido/Valley-Serrano (TE/VS): The currently designated Inventoried Roadless Areas are proposed for being redesignated as "Proposed Wilderness." In addition, a new "Proposed Wilderness" area has been proposed. The combination of these areas would likely make it impossible for the Forest Service to permit a transmission line.

2. **CNF Mount Palomar Area** (Alternatives 2 and 3): Highways 79 and 76 bound the Mount Palomar area on the north and south, and because the Forest Service land crosses the highways, a transmission line through this midsection of San Diego County would pass through small areas of Forest Service land.

3. **CNF Trabuco Ranger District** (Alternative 3, TE/VS Forest Route) would include more than 46 miles of Forest Service land, requiring a new 500 kV line along the eastern ridgeline of the Santa Ana Mountains overlooking Lake Elsinore. This is an area with intense recreational use, including hang gliding, and scenic views.

4. **SBNF land within the monument**: As described above (see "Immediately North of the Park, Highway 74"), there are lands of the SBNF within the monument. Transmission line siting through these areas would have to comply with both the national monument and the Forest Service regulations.

Tribal Land

The study area, as shown on Figure 4 on page 25, includes many large areas of land under the control of many tribal entities, including:

- Viejas Reservation
- Capitan Grande Reservation
- Santa Ysabel Reservation
- Mesa Grande Reservation
- La Jolla Reservation
- Rincon Reservation
- Pala Reservation
- Riverside County
- Pechanga Reservation
- Cahuilla Reservation
- Santa Rosa Reservation

While some processes on tribal land are overseen by the Bureau of Indian Affairs, the ability of utilities to cross tribal land is entirely controlled by the tribal governments. If the tribal members do not accept a utility's terms for an easement across tribal land, there is no appeal.

The Pechanga reservation, located at the southern boundary of Riverside County adjacent to Temecula, has expanded substantially since the Valley-Rainbow project was proposed, so the tribal government controls access to San Diego County across a stretch of land of nearly 6 miles from east to west.

Agua Tibia Wilderness

Agua Tibia Wilderness is a 15,933-acre protected area in southern Riverside and northern San Diego Counties. While it is mostly within the Palomar Ranger District of the Cleveland National Forest, it is managed by the BLM and the CNF. It was designated as wilderness in 1975. The wilderness is immediately adjacent to the Pechanga reservation, so the two properties together block north-south access between San Diego and Riverside Counties along a 12-mile stretch of the county line.

Highly Developed Temecula and Southern Riverside County

The northern portion of the study area has experienced dramatic growth in residential development over the past 15 years. This includes the Riverside County area around the City of Temecula (communities of Murrieta, Menifee, Winchester, Sun City, Lake Elsinore, and Hemet). When the Valley-Rainbow transmission line (500 kV overhead) was proposed through this area 13 years ago, it was strongly opposed by the southern Riverside County communities. The community expressed concerned about the winery industry, recreational lakes and parks, and residential development.

Since the Valley-Rainbow proposal, many proposed residential communities have been constructed, making it exceptionally challenging to find an overhead route through this area.

Rural Residential Areas: Scenic Values and Regional Parks

The northern half of San Diego County and the southern segment of Riverside County include scenic open spaces where undeveloped views are valued and protected.

Scenic Highways and Scenic Areas

Two types of scenic highways exist in the study area. State Route 78 is a designated scenic highway, passing through ABDSP. State Routes 76 and 79 are both designated as "eligible" for designation as scenic. These designations reinforce the local and regional concerns about maintenance of views, undeveloped areas, and open space, making transmission line siting difficult.

Electric and Magnetic Fields From Transmission Lines and Potential Health Concerns

One consideration when planning or siting new transmission lines is the public interest and concern regarding potential health effects from exposure to electric and magnetic fields (EMFs). There are three primary electrical parameters associated with the environment in the vicinity of transmission lines: 1) the electric field, 2) the magnetic field and 3) air ions (for DC lines). Additional detail is provided in Appendix B, Electric and Magnetic Fields From HVDC Transmission Lines and Potential Health Concerns.

- Both high-voltage alternating current (HVAC) and HVDC lines generate an electric field surrounding the conductors, with the magnitude of the electric field dependent on the voltage of the line. The strength of the static electric field decreases rapidly with distance from the source. Electric fields are shielded by trees, walls or other objects and, if shielded, do not penetrate the body, and adverse health effects have not been scientifically established. Some fish and marine organisms use electric fields to detect prey, find mates, and possibly to orient themselves, but there is limited evidence of specific effects of EMF.
- Both HVAC and HVDC lines generate magnetic fields. The magnetic field for a DC line is a static field that does not change over time much like the Earth's magnetic field. Static magnetic fields have been studied extensively at strengths significantly higher than for HVDC transmission lines due to their use in medical diagnostics. The available information does not indicate a significant increase or decrease in the prevalence of the diseases evaluated or conclude that exposure to DC magnetic fields affects health. Generally, conclusions surrounding the human health impacts of EMF also apply to potential impacts on marine species.
- *Air ions* are charged air molecules produced by corona, the partial electrical breakdown of the air surrounding conductors. A result of corona is both positive air ions that have lost an electron and negative air ions that have picked up the excess electrons. For HVDC lines air ions with the same polarity of the conductor migrate toward the opposite pole of the HVDC circuit, and a significant portion of the air ions migrate to the ground and away from the transmission line. Natural background air ion densities range from 1,000 ions per cubic centimeter in open areas to 80,000 ions per cubic centimeter in urban areas. Directly below HVDC

transmission lines air ion densities are in the range of 100,000 ions per centimeter. Air ions have been studied for more than a hundred years; research has not provided any reliable evidence that air ions produce any harmful effects.

Regulatory Requirements for Potential Land-Based Transmission

Table 1 lists the federal, State, and local permits and authorizations that may be required prior to constructing and operating a new high voltage transmission line within Imperial, San Diego, Riverside, Los Angeles, and/or Orange Counties.

Table 1: Permits That May Be Required for Overhead or Underground High-Voltage Transmission Line

Agency	Jurisdiction	Requirements	Applicable Alternative(s)
Federal Agencies			
Council on Environmental Quality, National Environmental Policy Act	Environmental review of major federal actions	▪ Compliance with NEPA: preparation of EIS	All
U.S. Fish and Wildlife Service	Endangered Species Act 16 USC 1531-1544 Migratory Bird Treaty Act and Eagle Protection Act Fish and Wildlife Coordination Act	▪ Biological Assessment, Section 7 Consultation, Biological Opinion ▪ Enforcement of the Migratory Bird Treaty Act (MBTA) ▪ Habitat Conservation Plans (HCP) – Riverside County	All for Section 7 Consultation and MBTA Enforcement; Alternative 6 for HCP
U.S. Army Corps of Engineers	Clean Water Act, 33 USC 1341 Section 10, Rivers and Harbors Act Permit	▪ Individual or Nationwide Section 404 Permit	All
U.S. Department of Transportation, Federal Highway Administration		▪ Encroachment Permits ▪ Review of obstruction and objects affecting airspace	All
U.S. Department of the Treasury, Bureau of Alcohol, Tobacco and Firearms	Where blasting may be required	▪ Explosive User's Permit	All
Federal Aviation Administration		▪ Helicopter Lift Plan ▪ Form 7460-1	All
Federal Communications Commission (FCC)	Licenses/permits related to FCC frequencies and paths	▪ Telecommunication Permit (as required)	All
U.S. Bureau of Indian Affairs, Pacific Regional Office	Section 106 of National Historic Preservation Act of 1966	National Historic Preservation Act (NHPA), Section 106 consultation	All
Advisory Council on Historic Preservation	National Register of Historic Places	NHPA, Section 106 consultation	All
U.S. Department of Agriculture - United States Forest Service		▪ Forest Plan amendment and Special Use Permit (SUP) authorization Easements or other real property conveyances ▪ Timber settlement sale	Alternatives 2, 3, 4, 5

Table 1: Permits That May Be Required for Overhead or Underground High-Voltage Transmission Line

Agency	Jurisdiction	Requirements	Applicable Alternative(s)
Bureau of Land Management	FLPMA, 43 USC 1701 et seq. 43 USC 1701 et seq.	▪ ROW Grant / Record of Decision ▪ Temporary Use Permit ▪ Antiquities and Cultural Resources Use Permit ▪ Plan of Development ▪ Notice to Proceed ▪ California Desert Conservation Area Plan Amendment ▪ Clean Air Act Conformity ▪ Fire Prevention Control Plan	Alternative2 2 through 6
U.S. Department of Defense (DOD)	If on DOD lands	▪ Federal Aviation Regulation (FAR) Part 77 Request (via FAA) ▪ Secretary of the Navy Instructions (SECNAVINST) 11011.47A (access road outside of easement)	Alternatives 3 and 4
Marine Corps Base (MCB) Camp Pendleton	Construction on MCB Camp Pendleton	▪ FAR Part 77 Request (via FAA) ▪ SECNAVINST 11011.47A (access road outside of easement) ▪ License for non-federal use of real property	Alternative 3 and 4
La Jolla, Pala	Section 106 of National Historic Preservation Act of 1966	▪ Section 106 consultation	Alternative 3, 4, 5
State Agencies			
California Public Utilities Commission	Transmission, substation, generation projects 50 kV and above	▪ CPCN ▪ Likely Lead Agency for CEQA and certification of EIR	All
California Independent System Operator	Purpose and Need for new transmission, substation and generation projects	▪ Interconnection approval	All
California Department of Fish and Wildlife	Manage fish, wildlife, plant resources and habitats; California Endangered Species Act (ESA), California Native Plant Protection Act, California Fish and Game Code Section 1601	▪ Streambed Alteration 1601 Permit ▪ Section 2061 Incidental Take Permit ▪ Mitigation agreement/plan ▪ Certification of EIR ▪ Easement	All
California Department of Transportation (Caltrans) Districts 7, 8, 11, and 12	State-owned streets and highways Code 660-711.21 Cal. Code of Regs. 1411.1-1411.6	▪ Encroachment/Crossing Permits ▪ Traffic Control Plans ▪ Oversize Load/Special Load Permit ▪ Temporary Helicopter Landing Site Permit	All

Table 1: Permits That May Be Required for Overhead or Underground High-Voltage Transmission Line

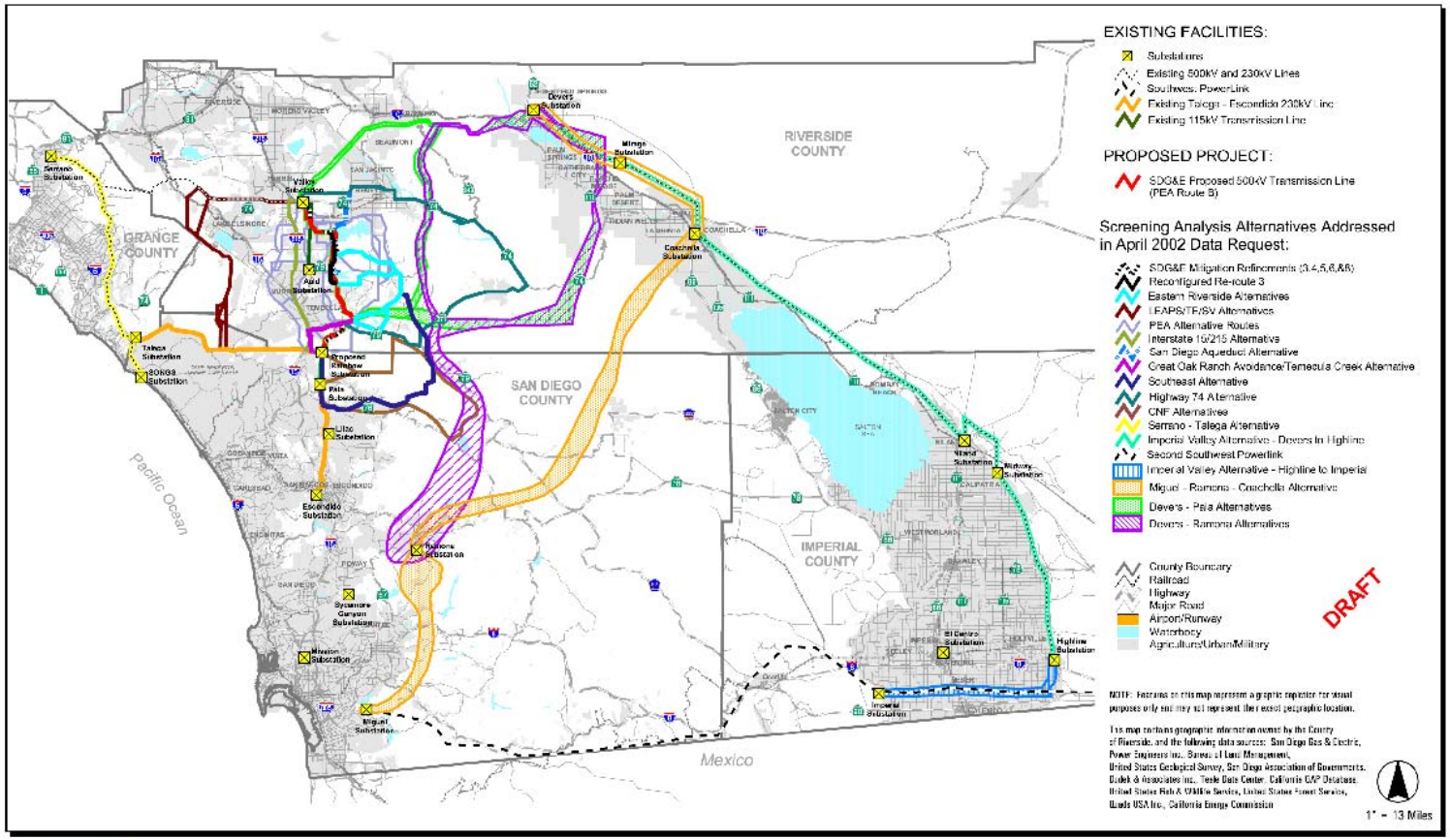
Agency	Jurisdiction	Requirements	Applicable Alternative(s)
California Department of Toxic Substances Control (DTSC)	Hazardous Waste Control Act of 1972	▪ EPA Hazardous Waste Generator Identification Number ▪ Permit for hazardous waste treatment, storage and disposal ▪ Hazardous Material Business Plan	All
California State Historic Preservation Office	Any archaeological or paleontological work	▪ Cultural Resources Use Permit, Field Use Authorization, or an Archaeological Resources Protection Act (ARPA) Permit (if required) ▪ Consultation for Section 106 of the National Historic Preservation Act	All
California Air Resources Board	Statewide	▪ Portable Engine Registration for specified non-mobile portable engines.	All
California State Water Resources Control Board	Clean Water Act, Section 401	▪ 401 Certification	All
California Department of Industrial Relations Division of Occupational Safety and Health		▪ Construction activities permit ▪ Tower cranes permit ▪ Helicopter operations permit and tunneling permit	All
California State Lands Commission	State lands	▪ Right-of-Way Easement	Alternatives 2 through 5
California Department of Parks and Recreation	State Park Lands (Anza-Borrego Desert State Park)	▪ Easement	Alternative 5
California Park and Recreation Commission	State Park Lands (Anza-Borrego Desert State Park)	▪ Plan Amendment ▪ Change in Wilderness Designation	Alternative 5
Department of Water Resources	Water crossings	▪ Encroachment/Crossing Permit (as required)	All
Regional Agencies			
Regional Water Quality Control Board ▪ Region 4 (Los Angeles) ▪ Region 7 (Colorado River Basin) ▪ Region 8 (Santa Ana) ▪ Region 9 (San Diego)	Clean Water Act, Section 401	▪ 401 Certification ▪ Storm Water Construction General Permit 99-08-DWQ ▪ National Pollutant Discharge and Elimination System (NPDES) Permit ▪ Waste Discharge Requirements (WDRs)	All

Table 1: Permits That May Be Required for Overhead or Underground High-Voltage Transmission Line

Agency	Jurisdiction	Requirements	Applicable Alternative(s)
South Coast Air Quality Management District (SCAQMD); San Diego Air Pollution Control District (SDAPCD); or Imperial County Air Pollution Control District (ICAPCD)	South Coast Air Basin; San Diego Air Basin; or Salton Sea Air Basin	Portable Equipment Registrations; Authority to Construct and Permit to Operate backup diesel generator for black start capability (if required).	All
Imperial Irrigation District (IID)	District irrigation/drainage channels	▪ Encroachment/Crossing Permit ▪ Easements and ROW Grant	Alternative 5
Local Agencies, Municipalities, and Other Entities			
Counties ▪ Imperial County ▪ Los Angeles County ▪ Orange County ▪ Riverside County ▪ San Diego County	County roads and highways, flood control/drainage channels	▪ Road/Highway Encroachment/Crossing Permit ▪ Grading and Wall Permits ▪ Traffic Control Plans ▪ Temporary Street/Land Closure Permit ▪ Explosives Permit ▪ New or expanded ROW Grant ▪ Flood Control/Drainage Channel Encroachment/Crossing Permit ▪ Excavation Permit ▪ Tree Removal Permit (if required)	All
Cities ▪ San Diego ▪ Poway ▪ Escondido ▪ Encina ▪ Lake Elsinore ▪ Wildomar ▪ Menifee ▪ Grand Terrace ▪ Ontario ▪ Rancho Cucamonga ▪ Redlands	City roads and highways, flood control/drainage channels, lands	▪ Road/Highway Encroachment/Crossing Permit ▪ Flood Control Channel ▪ Encroachment/Crossing Permit ▪ Temporary Use/Occupancy Permit – Material and Storage Yards ▪ Regional Water Quality Control Board – Storm Water Pollution Prevention Plan ▪ Tree Removal Permit (if required)	All
Riverside County Habitat Conservancy Agency (RCHCA)	Construction on RCHCA lands	▪ Crossing Permit	Alternatives 2 and 3

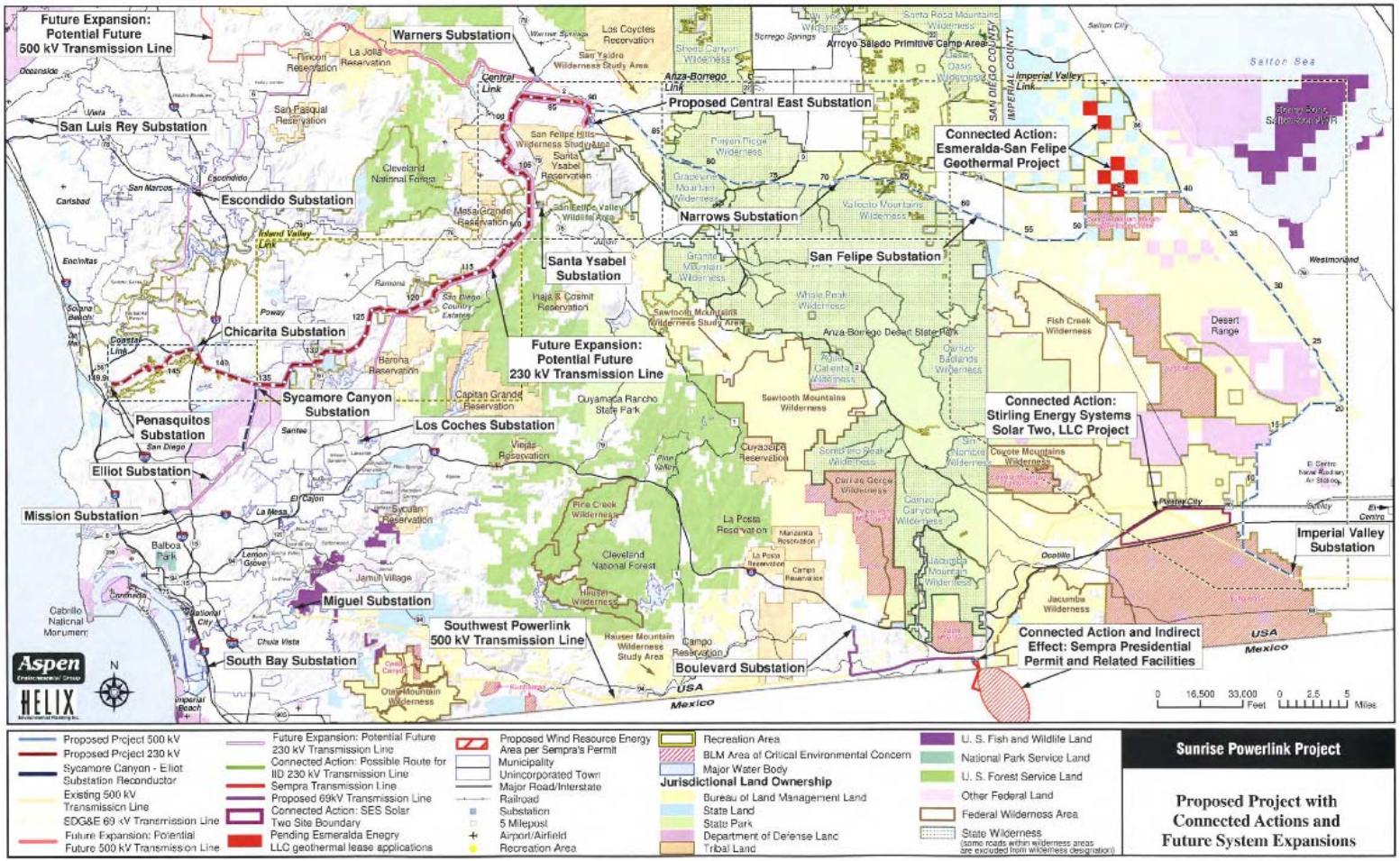
Source: Aspen Environmental, 2014

Figure 1: CPUC Valley-Rainbow Alternatives Evaluated



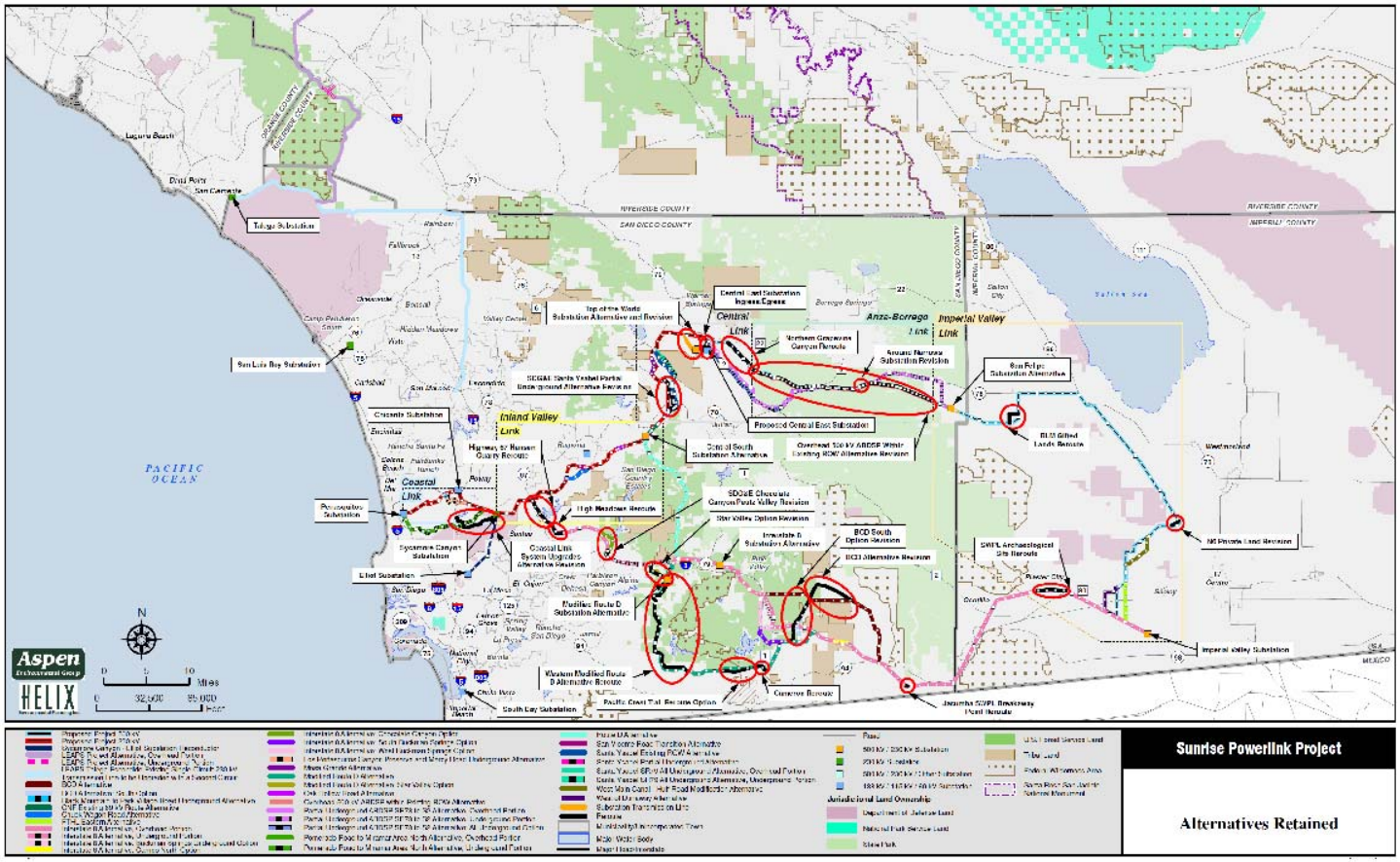
Source: http://www.cpuc.ca.gov/environment/info/dudek/valleyrainbow/V2R/fig_es-3.gif

Figure 2: Proposed Project With Connected Actions and Future System Expansions



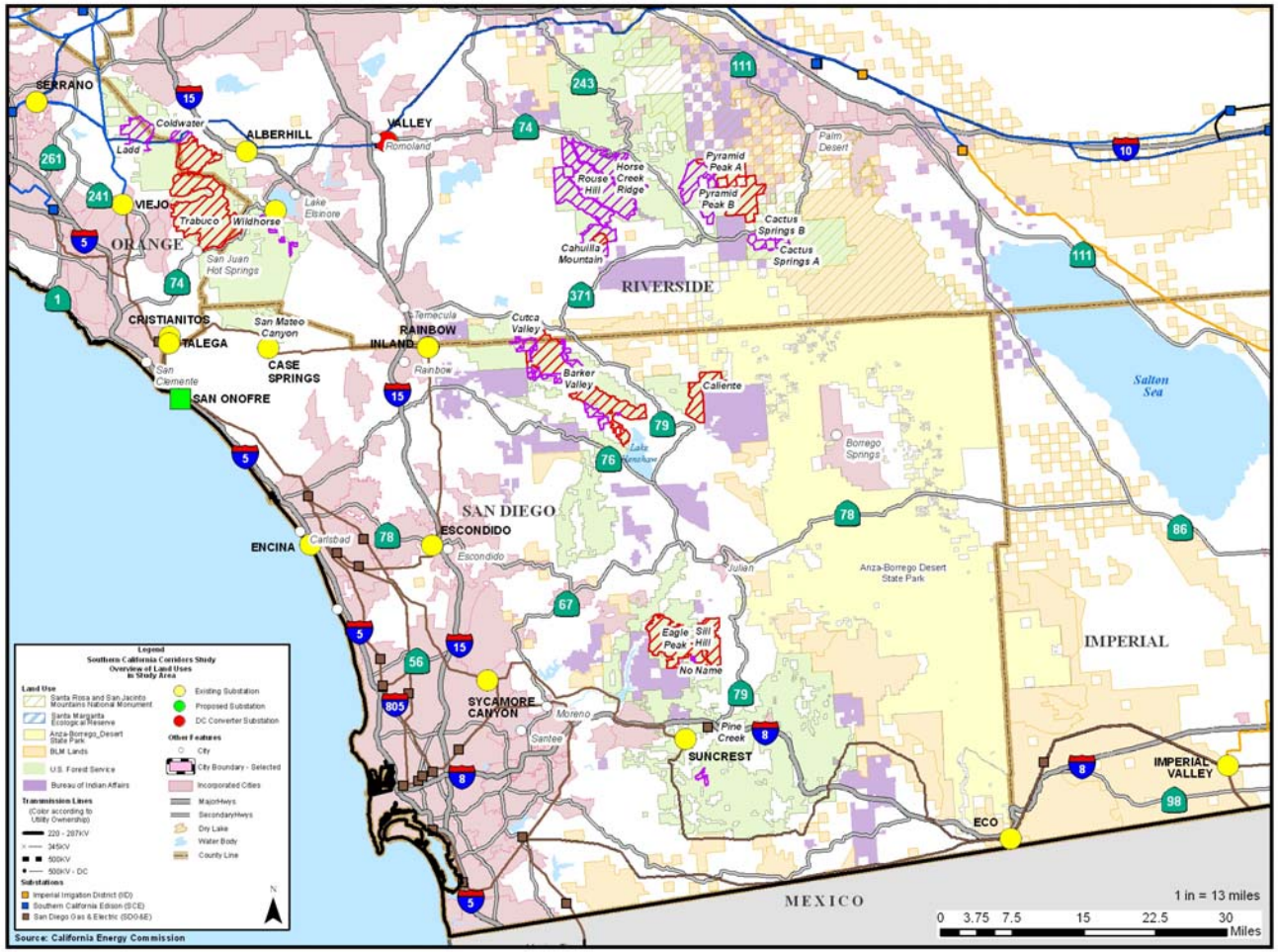
Source: CPUC and US BLM, 2008: http://www.cpuc.ca.gov/Environment/info/aspen/sunrise/toc-feir.htm

Figure 3: Alternatives Retained



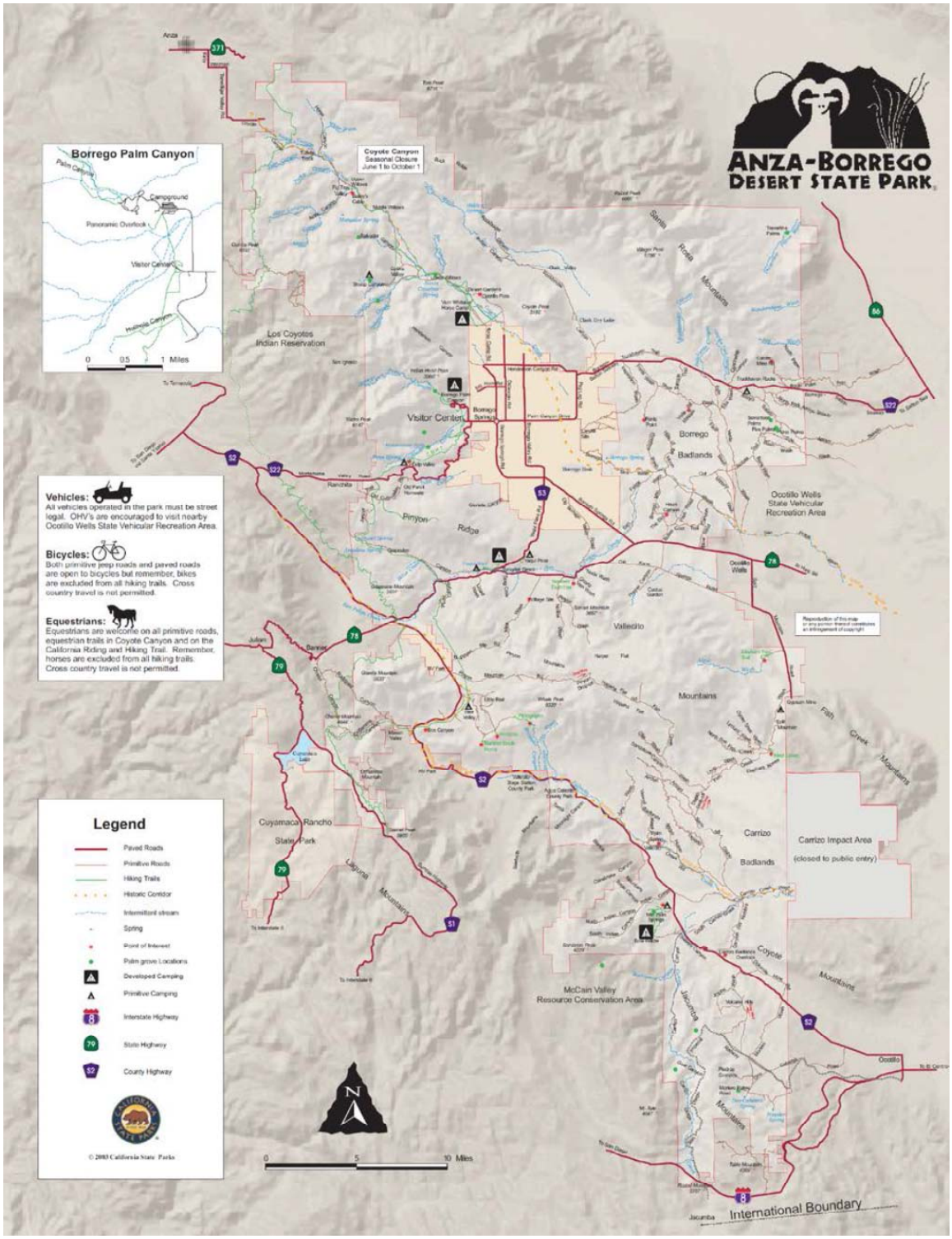
Source: CPUC and US BLM, 2008: http://www.cpuc.ca.gov/Environment/info/aspen/sunrise/toc-feir.htm

Figure 4: Overview of Land Uses in Study Area



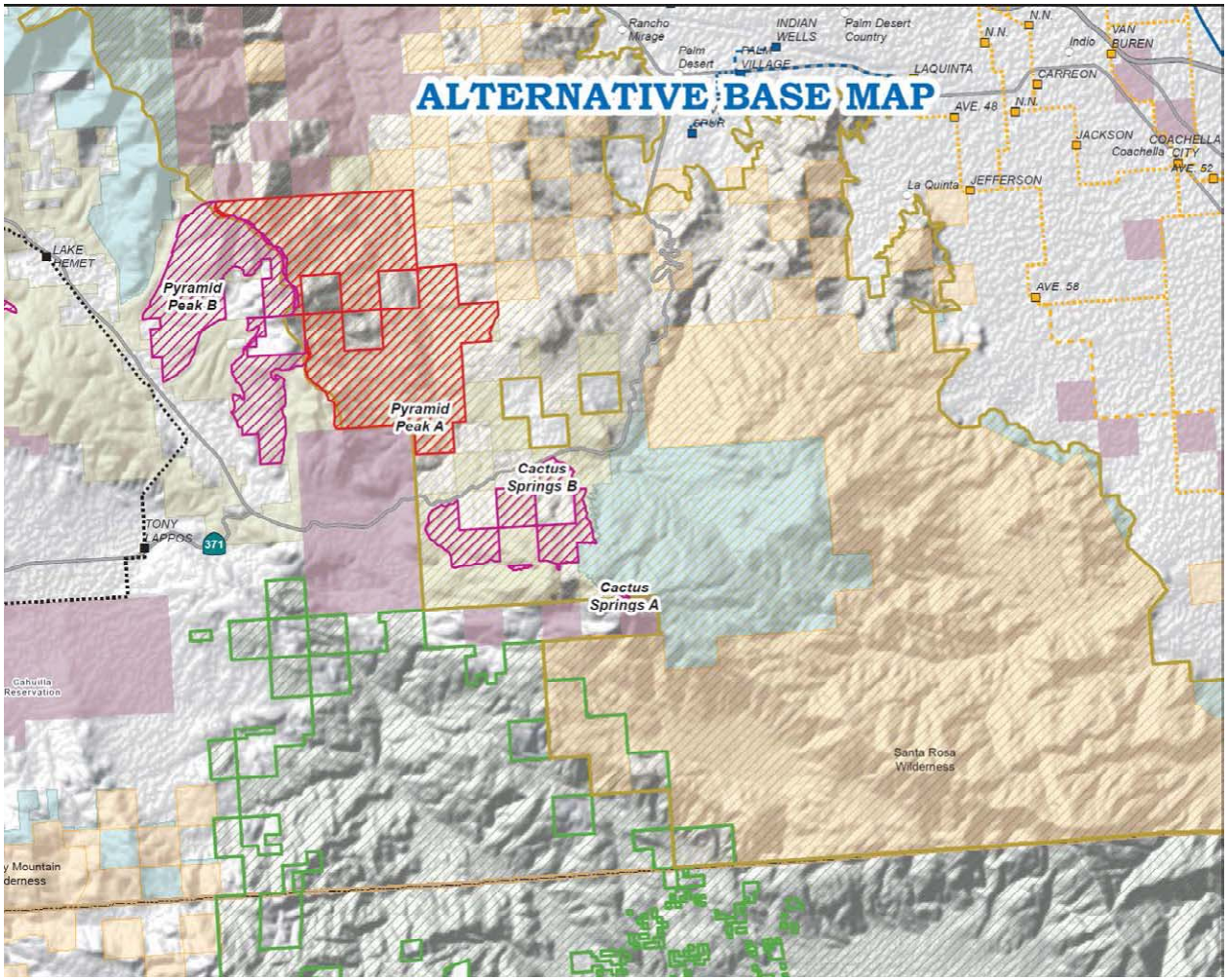
Source: California Energy Commission, 2014

Figure 5: Potential Transmission Line Crossings of Anza-Borrego Desert State Park



Source: California State Parks, 2014.

Figure 6: Santa Rosa-San Jacinto Mountains National Monument



Source: Aspen Environmental, 2014

CHAPTER 2:
Onshore Transmission Alternatives − Description of Potential Routes and Constraints

Chapter 1 of this report describes the siting challenges that exist in the study area. This chapter describes each of the onshore alternatives and summarizes the major constraints and land-use challenges for each route. Appendix A details the potential routes that were developed to allow assessment of routing constraints.

This chapter addresses onshore routes only; Alternative 1, the submarine HVDC alternative, is addressed in Chapters 3, 4, and 5. Additional technical information about HVDC lines is addressed in Section 3. This chapter is organized as follows:

- Overview of Alternative Corridors and Segments.
- Alternative 2, Alberhill to Suncrest.
- Alternative 3, Enhanced TE/VS (Forest Route).
- Alternative 4, Enhanced TE/VS (Talega-Serrano Route).
- Alternative 5, Imperial Valley to Inland (Overhead AC and Overhead/Underground DC).
- Alternative 6, Valley to Inland (Overhead AC or Underground DC).
- Alternative 7, Imperial Valley Expansion.
- Alternative 8, Mesa Substation Loop-In.

Overview of Onshore Alternative Corridors and Segments

The five onshore transmission routes (Alternatives 2 through 6) that are evaluated in this study have some transmission segments in common and also interconnect a variety of substations.

Table 2 shows the transmission segments that each alternative would use, and Table 3 shows the substations with which each alternative would interconnect. Figure 7 on page 61 is a map showing, in a schematic manner, all the substations and segments that would be affected by the onshore alternatives. All figures are presented at the end of Chapter 2.

Table 4 presents an overview of transmission line length and jurisdictions for each of the onshore alternatives. The first two rows present the length of each alternative; the length provided in the original route descriptions differs from the length of each route based on the routing defined in this report. The routes were not mapped in the original descriptions, so it is not possible to explain the differences between the original miles and those described and illustrated in this report.

Table 2: Transmission Segments for Onshore Alternatives

	Alt 2 Alberhill to Suncrest	Alt 3 TE/VS (Forest)	Alt 4 TE/VS (Talega–Serrano)	Alt 5 Imperial Valley–Inland	Alt 6 Valley–Inland
500 kV – Alberhill to Warner	x				
500 kV – Alberhill to Case Springs		x			
500 kV – Talega to Case Springs to Inland		x			
500 kV – Inland to Warner		x	x		
500 kV – Warner to Suncrest	x	x	x		
500 kV – Serrano to Talega			x		
500 kV – Talega to Inland			x		
500 kV – Imperial Valley to Inland				x	
HVDC Option – Imperial Valley to Inland				x	
500 kV – Valley to Inland					x
HVDC Option – Valley to Inland					x
2 x 230 kV – Inland to Escondido (new double circuit)		x	x		
230 kV – Talega to Escondido (reconductor; upgrade to double circuit; loop into Inland Sub.)				x	x

Source: Aspen Environmental, 2014

Table 3: Substations by Alternative

	Alt 2 Alberhill to Suncrest	Alt 3 TE/VS (Forest)	Alt 4 TE/VS (Talega–Serrano)	Alt 5 Imperial Valley–Inland	Alt 6 Valley–Inland
Alberhill (New 500/115 kV)	x	x			
Case Springs (New 500 kV)		x			
Inland (New 500 kV)		x	x	x	x
Suncrest (Existing 500/230 kV)	x	x	x		
Talega (Add 500 kV to 230/138 kV)		x	x		
Talega (Existing 230 kV)				x	x
Serrano (Existing 500/230 kV)			x		
Escondido (Existing 230 kV)		x	x	x	x
Imperial Valley (Add 500 kV or HVDC)				x	
Valley (Add 500 kV or HVDC)					x
San Onofre and Huntington Beach (Synchronous Condenser Sites)		x	x		
Japanese Mesa (SDG&E San Onofre Nuclear Generating Station (SONGS) Mesa 69 kV) (Phase Shifter Site)				x	x

Source: Aspen Environmental, 2014

Table 4: Routing Details and Land Jurisdiction by Alternative

	Alt 2 Alberhill to Suncrest	Alt 3 TE/VS (Forest)	Alt 4 TE/VS (Talega–Serrano)	Alt 5, 1A Imperial Valley–Inland (500 kV)	Alt 5, 1B Imperial Valley–Inland (HVDC)	Alt 6, 2A Valley–Inland (500 kV)	Alt 6, 2B Valley–Inland (HVDC)
Length in Original Description Provided	65.0	137.2	n/a	145	145	35	35
Length of New 500 kV or HVDC based on potential routing presented in this report	105.3	138.6	142.4	140.0	142.2	40.0	30.0
Length of Underground Segment(s)	0	0	0	0	36.3	0	29.9
BLM Land	0.4	0.3	0.3	33.3	32.8	0	0
Forest Service Land	17.7	46.3	21.9	2.2	2.2	0	0
Military Land (Pendleton)	0	10.0	10.2	0	0	0	0

Table 4: Routing Details and Land Jurisdiction by Alternative							
	Alt 2 Alberhill to Suncrest	**Alt 3 TE/VS (Forest)**	**Alt 4 TE/VS (Talega–Serrano)**	**Alt 5, 1A Imperial Valley–Inland (500 kV)**	**Alt 5, 1B Imperial Valley–Inland (HVDC)**	**Alt 6, 2A Valley–Inland (500 kV)**	**Alt 6, 2B Valley–Inland (HVDC)**
State Lands Commission	0.8	2.0	2.0	0.7	5.1	0	0
State Parks	0	0	0	19.6	19.9	0	0
Tribal Land	0	3.6	3.6	3.6	3.6	0	0
Unincorporated County	61.5	76.0	88.8	80.6	78.2	32.0	11.2
Incorporated City	24.7	0	15.2	0	0	6.5	18.7

Source: Aspen Environmental, 2014

Alternative 2: Alberhill to Suncrest

ALTERNATIVE 2 DESCRIPTION
SCE Alberhill – SDG&E Suncrest 500 kV

- Construct 105 miles of new 500 kV line (70 percent compensation) from SCE's Alberhill to SDG&E's existing Suncrest substation. Alberhill Substation is located between SCE's existing Valley and Serrano Substations, at the northwest corner of the intersection of Temescal Canyon Road and Concordia Ranch Road in unincorporated western Riverside County. This substation is expected to be in service in 2015.
- Convert either one of San Onofre generating units to 700 MVAR synchronous condensers or install one new 700 million volt-amperes (MVAR) static reactive volt-amperes (VAR) compensator (SVC) to be connected to San Onofre 230 kV switchyard.

Note: The original description of Alternative 2 estimated 65 miles for new 500 kV line, but there are about 80 miles between Alberhill and Suncrest Substations as the crow flies. The 105-mile-long potential route defined in this report follows existing transmission line ROWs and highways.

In terms of evaluating potential routing constraints, the most significant component of this alternative is the following:

- New 500 kV transmission line from SCE's proposed Alberhill Substation in Riverside County to SDG&E's Suncrest Substation in San Diego County.

The San Onofre Substation components described above have no major siting or permitting challenges, so they are not addressed in this report.

Alternative 2 Routing Summary

Appendix A presents details on the potential route for each alternative, including a description of the route itself and the land uses along the route. This section presents a brief overview of the route as background for the discussion of routing constraints.

There are few options for a potentially feasible 500 kV overhead high-voltage line between Alberhill and Suncrest Substations. Figure 8 illustrates the general route defined for this study; this potential route would face likely insurmountable obstacles in the first and third segments defined below.

- Riverside County segment: Alberhill through Temecula. Densely developed with homes and commercial buildings.

- North San Diego County segment: Following Highways 76 or 79. Low density of homes, but requires passing through USFS or tribal land and scenic inland North County.

- South San Diego County segment: Into Suncrest Substation from the north. USFS land with restricted land-use designations. West of Suncrest the density of residential development is too high for a 500 kV line to be installed.

Alternative 2 consists of a single-circuit 500 kV overhead transmission line between SCE's proposed Alberhill Substation, near Interstate 15 in Riverside County, and SDG&E's existing Suncrest Substation, south of Interstate 8 in San Diego County. The line would require acquisition of new ROWs along nearly the entire route and would not interconnect with other substations between Alberhill and Suncrest.

As shown in Figure 8 on page 62, the route would begin at the SCE Alberhill Substation site, just east of the city of Lake Elsinore and near I-15. For this potential route, the 500 kV transmission line would follow the Caltrans I-15 freeway corridor south for roughly 24.5 miles into Temecula. It would then turn east to follow Highway 79 for about 38 miles to near Warner Springs in San Diego County. Then the route would turn south, staying west of Highway 79 for 15 miles to Santa Ysabel, where it would turn southeast and parallel Highway 78 (Julian Road) for approximately 3.5 miles before turning south into the CNF for approximately 12 miles, crossing I-8 and terminating at Suncrest Substation east of the community of Alpine.

Much of this overhead route would be easier to site assuming use of tubular steel poles (TSPs) rather than lattice towers. As described in Appendix C (Right-of-Way Requirements), the narrower base of the TSPs allows construction in a more constrained space.

Alternative 2 Constraints

The major constraints on the Alternative 2 route are those listed below. Each issue is described in more detail in the following paragraphs.

1. Dense development in Temecula.

2. Longitudinal encroachment within Caltrans I-15 ROW.

3. U.S. Forest Service lands with restricted land-use designations.

4. Scenic and low-density residential areas in northern San Diego County.

5. Glider and small aircraft airport near Warner Springs.

Constraint 1: Routing through Temecula

The strong opposition of Temecula residents to the SDG&E proposed Valley-Rainbow 500 kV line was instrumental to the ultimate failure of that project, which was cancelled after CPUC analysis of alternatives in 2002. Between 2000 and 2010, the Temecula population increased from about 58,000 to more than 100,000. The city is densely populated east of I-15, and the development of a viable overhead high-voltage route through the city is unlikely.

The two possible options for routing a 500 kV line through Temecula would be to follow the edge of the Temecula River or to follow Highway 79 (Temecula Parkway). It would likely be very challenging to find adequate ROW for an overhead route for either option. An underground route along Temecula Parkway may be feasible (as is being demonstrated in Chino Hills for the TRTP), but the high cost and disturbance required for installation of a 500 kV AC line underground should make that technology a last resort for very unusual situations. Appendix C addresses ROW requirements for overhead and underground high-voltage transmission lines.

Constraint 2: Use of I-15 Caltrans ROW

There are two possible north-south transmission options between the general areas of the Alberhill and Inland Substations. Alternative 3 considers a route from Alberhill to Suncrest that does not affect the Caltrans ROW, following the proposed TE/VS (Lake Elsinore Advanced Pumped Storage Project) transmission route along the eastern edge of the CNF. The route presented for Alternative 2 through this part of Riverside County would use the space remaining in the I-15 Caltrans ROW. Appendix D presents the Caltrans regulations; relevant sections are excerpted in Table 5 (California Department of Transportation, 2013). The regulations explain that exceptions to the prohibition of utility installations within controlled-access roadways can be made only where it is "impossible or unreasonably costly to locate utilities outside of the controlled right of way." Exceptions for encroachments on freeway ROWs must be submitted to the Division Chief of the Division of Design, who has decision-making authority. While overhead transmission and distribution lines commonly cross Caltrans ROWs around the state, no longitudinal encroachments have been approved.

Table 5: Caltrans Regulations: New Utility Longitudinal Encroachments

With the exception of special cases permitted under strictly controlled conditions, **new utilities will *not* be permitted to be installed longitudinally within the access control lines of any freeway or expressway**—including installations on structures that cross major valleys or rivers and installations through tunnels. Utilities will not be allowed to be installed longitudinally within the median area. Utilities that transport hazardous materials will not be allowed in a vehicular tunnel under any circumstances.

These provisions were established to provide for the maximum degree of safety and to preserve the traffic-carrying capacity, both of which are warranted by the large public fund investment in freeways. **Exceptions can be made at locations where circumstances make it impossible or unreasonably costly to locate utilities outside of the access controlled right of way.** To the extent feasible and practicable, any utility installations allowed within access controlled rights of way should be located so that they can be serviced and maintained from outside the right of way. [**emphasis** added]

Source: California Department of Transportation, Project Development Procedures Manual, 06/21/2013, http://www.dot.ca.gov/hq/oppd/pdpm/chap_pdf/chapt17.pdf

As part of the CPUC's assessment of the TE/VS Project, a preliminary assessment of use of the I-15 corridor as a transmission route was prepared by Commonwealth Associates (Commonwealth Associates Inc., 2002). The review determined that it was feasible to install a 230 kV circuit in the I-15 corridor entirely on Caltrans ROW. Constraints were identified near some residential and commercial areas that would require taller poles and restrained insulators.

A cursory review of a 500 kV option also was performed. Commonwealth concluded that due to the required support structures and ROW width, it was unlikely that a 500 kV line could be constructed along this corridor. Ideal ROW widths for 500 kV lines are in the range of 160 feet or more, and Commonwealth concluded that the I-15 corridor could not accommodate traditional construction of this type of ROW. However, this study assumed that the line would be exclusively in the Caltrans ROW. No evaluation was made of whether a 500 kV line would be feasible using a combination of Caltrans ROW and adjacent properties. Based on a review of aerial photography, potential routes through the general area using both Caltrans ROW and other properties may exist. In this case, the route would be on or adjacent to Caltrans ROW in largely undeveloped areas and would diverge from the freeway into undeveloped mountainous terrain to skirt developed areas.

While it may be technically feasible to use a combination of Caltrans ROW and other properties in the I-15 corridor for construction of a 500 kV line, it is unknown whether or under what conditions Caltrans would permit installation of structures in its ROW.

Constraint 3: Crossing CNF Lands With Restricted Land-Use Designations

The southernmost segment of this alternative would have to pass through the CNF Palomar Ranger District and cross the San Diego River. The route would pass through the No Name roadless area, crossing into the CNF Descanso Ranger District. The CNF has proposed to convert the "Inventoried Roadless Areas" to "Proposed Wilderness" and to designate additional land along the San Diego River canyon as wilderness. A Draft Record of Decision presenting the Forest Service's preliminary decision on this action was issued in January 2014 but until it is signed the "Inventoried Roadless Areas" designation remains in place. The proposed installation of a high-voltage transmission line through these land designations would almost certainly be prohibited by the CNF.

Constraint 4: Scenic and Dispersed Residential Areas and Tribal Concerns in Northern San Diego County

The inland valleys of southern Riverside and northern San Diego Counties are generally open landscapes characterized by grazing, agriculture, and scattered homes. There are many large areas of tribal land in the region, and while the potential route for Alternative 2 does not pass through tribal lands, there would be concerns about effects on Native American resources and values.

Constraint 5: Small Airport Near Warner Springs

A landing strip used by small aircraft and gliders is located west of Warner Springs next to the highway. Continued use of the landing strip would be threatened by an adjacent 500 kV transmission line. There is extensive open space on Vista Irrigation District land that could accommodate a ROW reroute to address this issue and avoid going through Warner Springs.

Alternative 3: Enhanced TE/VS (Forest Route)

ALTERNATIVE 3
Enhanced Talega-Escondido/Valley-Serrano (TE/VS) 500 kV Transmission, Option 1 (Forest Route)

- Construct 30.3 miles of new 500 kV line from SCE's Alberhill Substation to new Case Springs Substation (located south of new Lake Elsinore Advanced Pumped Storage [LEAPS] Substation).
- Construct 12.4 miles of 500 kV line from new Case Springs Substation to SDG&E's Talega Substation.
- Construct 17.6 miles of new 500 kV line from new Case Springs Substation to new Inland 500 kV Substation in northern San Diego County.
- Construct 66.7 miles of new 500 kV line from new Inland Substation to SDG&E existing Suncrest Substation; this line will be 70 percent compensated (in other words, series caps are needed).
- Total new 500 kV line is 127.0 miles long.

Upgrades:

- Upgrade the existing Talega Substation from 230/138 kV to 500/230/138 kV.
- Construct 21.7 miles of two new 230 kV lines (double-circuit tower line) from new Inland to SDG&E's existing Escondido Substation.
- Reconfigure the existing San Onofre–Santiago (2) 230 kV lines, San Onofre–Serrano 230 kV, San Onofre–Viejo 230 kV to have these become Talega-Santiago (2), Talega-Serrano (1), Talega-Viejo (1) 230 kV lines. The other existing lines terminating at Talega are Talega–San Onofre (3) and Talega-Tap-Capistrano 230 kV lines.
- Convert either one of San Onofre generating units to 700 MVAR synchronous condensers or install one 700 MVAR SVC to be connected to San Onofre 230 kV switchyard.
- Retain Huntington Beach Units 3 and 4 as synchronous condensers in the event that AES does not have PPA or other means of financing to proceed with repowering of these units.
- Convert HB Units 1 and 2 to synchronous condensers in the event that AES does not have PPA or other means of financing to proceed with repowering of these units.

In terms of evaluating potential constraints, the most significant components of this alternative are:

- New 500 kV transmission line 127 miles long, from SCE's proposed Alberhill Substation in Riverside County to SDG&E's Suncrest Substation in San Diego County (via Lake Elsinore Advanced Pump Storage [LEAPS], Case Springs, Inland Substations).

- Expansion of Talega Substation from 230/138 kV to 500/230/138 kV.

- New 500 kV transmission line connecting new Case Springs Substation to SDG&E's Talega Substation.

- Addition of a second 230 kV circuit to existing Talega to Escondido 230 kV towers (only between Inland and Escondido).

The constraints associated with the first three items listed above are presented in this section. The existing Talega-Escondido 230 kV transmission line heads east from Talega, then turns south to reach Escondido. At that turn, a proposed new Inland Substation is shown on the maps. The existing Talega-Escondido 230 kV line has a vacant position for a second 230 kV circuit between the proposed Inland Substation and Escondido. No environmental or permitting constraints have been identified for this potential upgrade given that the poles already exist and only the conductors and insulators would need to be added. The other components described above have no major siting or permitting challenges, so are not addressed in this report.

Alternative 3 Routing Summary

Appendix A presents details on the potential route for each alternative, including a description of the route itself and the land uses along the route. This section presents a brief overview of the route as background for the discussion of routing constraints.

Figure 9 illustrates the potential route for Alternative 3. Overall, a 500 kV route from Alberhill Substation through CNF to Inland Substation would be roughly 60 miles long. From Alberhill Substation, the new 500 kV line would extend about 32 miles to a new Case Springs Substation and then an additional 18 miles to Inland Substation. A 500 kV line would extend west from Case Springs for about 14 miles to Talega Substation. From Inland Substation, the 500 kV line would continue south to near Lilac Substation, then head east to Warners Substation before heading south to Suncrest Substation. In addition, two new 230 kV lines would be installed in the ROW between Inland and Escondido Substations

This alternative suggests a 500 kV interconnection between SCE's 500 kV Valley-Serrano line and SDG&E's 230 kV Talega-Escondido ROW, following the route proposed by The Nevada Hydro Company as part of its LEAPS Project (The Nevada Hydro Company, 2011; Federal Energy Regulatory Commission, 2007). Because the 500 kV line would connect the Talega-Escondido line with the Valley-Serrano line, the interconnection was referred to as the "TE/VS" project. The TE/VS interconnect was proposed to extend from SCE's Valley-Serrano transmission line by way of a new switchyard near I-15 at Corona (Lee) Lake, about 2 miles northwest of SCE's Alberhill Substation site, to a 500/230 kV Case Springs Substation, where it would loop in SDG&E's existing Talega-Escondido 230 kV line. It is assumed that the Alternative 3 alignment would begin at Alberhill Substation, extend north along I-15, then follow the TE/VS alignment. Currently, there is no active application before the CPUC for the TE/VS project.

This potential alternative follows Highway 76, based on SDG&E's suggestion of this route as part of a potential "500 kV Full Loop" during the Sunrise Powerlink EIR/EIS process. However, Highway 76 passes through the Rincon and La Jolla reservations, which would be avoided by following Highway 79 to the north. The alternative route, Highway 79, passes through central Temecula, as described for Alternative 2. Both routes face serious challenges.

The 500 kV project segments would include the following segments:

- New ROW using the TE/VS route from Alberhill to Case Springs.
- New 500 kV adjacent to the existing Talega-Escondido ROW from Case Springs west to Talega.
- New 500 kV from Case Springs east to Inland.
- South from Inland Substation to Lilac. The 500 kV circuit would share the same ROW as the existing single circuit 230 kV Talega-Escondido line and the new double circuit 230 kV Inland-Escondido line.
- The remainder of the unincorporated San Diego County route in the new ROW.

The 230 kV upgrade segments of the Talega-Escondido line would be developed in various line configurations:

- The two new 230 kV circuits could be developed as a new double-circuit line, adjacent to the existing Talega-Escondido line.
- One new circuit could be added to the existing 230 kV Talega-Escondido line on the vacant side and a new single-circuit 230 kV line be added in the ROW.
- One new circuit could be added to the existing 230 kV towers, and the second new circuit could be installed on new towers that also carry the new 500 kV circuit.
- Depending on design considerations, the existing 69 kV circuit between Pala and Lilac Substations could remain on the spare position on the original 230 kV towers, be installed on the same towers (as an "underbuild"), or be moved to separate poles.

Alternative 3 Constraints

The major constraints on the Alternative 3 route are those listed below. Each constraint is described in more detail in the following paragraphs, except where they are described for Alternative 2 (in that case, the discussion in Chapter 2, "Alternative 2 Constraints" is referenced).

1. ROW across La Jolla reservation
2. Expansion of Talega Substation

3. TE/VS route through CNF Trabuco Ranger District; CNF concerns
4. Expansion of ROW through Camp Pendleton
5. Crossing CNF lands with restricted land-use designations
6. Scenic and low-density residential areas in northern San Diego County
7. Expansion of ROW through Santa Margarita Ecological Reserve

Constraint 1: ROW Across La Jolla Reservation

Because tribes are independent of the federal or state governments, their land is not subject to eminent domain, and transmission lines must be sited with full agreement of the tribal government and members. For this reason, transmission line siting normally avoids all tribal land. However, Alternative 3 would cross tribal lands because:

- SDG&E has existing ROWs for 69 kV line across the La Jolla reservation, and SDG&E defined this as a potential route for its "500 kV Full Loop" in the Sunrise Powerlink evaluation process.

Constraint 2: Expansion of Talega Substation

Alternative 3 would require expansion of the Talega Substation to allow the addition of a 500 kV interconnection. This substation is located between San Clemente and Camp Pendleton. Portions of the substation are within Marine Corps boundaries, and expansion would require Marine Corps approval. The substation upgrades would enlarge the substation footprint to accommodate additional circuits and equipment. The substation may double in size to accommodate these changes, although its size might be reduced through the use of gas-insulated rather than air-insulated equipment. The design and construction of the line configurations would require coordinated planning and cooperative use of the adjacent ROWs by SCE and SDG&E. Additional land for ROW and substation expansion would be on either private property or at Camp Pendleton.

The land needed for additional ROW and an enlarged substation is on a corner of Camp Pendleton as well as on private land. Use of additional Camp Pendleton land would require an agreement with the Department of the Navy. Roughly half of the substation is on Camp Pendleton property, with the rest extending north into Orange County. Immediately north of the substation is San Clemente and unincorporated Orange County. San Onofre State Park is south of the substation on land leased by the state from Camp Pendleton through 2021. The park extends from the substation south along the county line to Interstate 5 (I-5).

Figure 10 on page 64 presents the topography and an aerial photo of the substation. It appears to be located on the top of a graded hill, with downward slopes to the east, west, and south. Expansion of the substation boundaries does not appear to be feasible without major grading and earth moving.

One option to consider is the expansion of the Cristianitos Substation, located about 3,500 feet north of Talega. This small substation is not adjacent to Camp Pendleton and is sited on more level topography. If the 500 kV system could use this substation as its point of interconnection, this appears to be a more feasible site. Cristianitos Substation is in unincorporated Orange County, east of Cristianitos Canyon Creek. The land immediately adjacent to this substation is vacant in all directions. Conceivably, the Cristianitos Substation could be expanded and replace Talega Substation or be integrated electrically with Talega, with rerouted lines.

It would be necessary to develop an agreement between SCE and SDG&E on how to configure the lines in and out of the Talega Substation and enlarge and configure the substation to meet their respective needs. SDG&E likely would need to underground its 69 kV line and to allow use of 10 to 20 feet of its ROW width to accommodate the 500/230 line.

Constraint 3: TE/VS Route Through CNF Trabuco Ranger District; CNF Concerns

The Federal Energy Regulatory Commission (FERC) published a final EIS in 2007 that evaluated the TE/VS route through the CNF, and the CNF issued a record of decision approving the project. However, this decision and the EIS are now more than 6 years old, and they may no longer be valid. If a new impact analysis is required for the CNF, the assessment would be much more rigorous, given the Forest Service processes that have been implemented since 2007. It is not certain that the prior approval for this route segment would be granted in 2014.

CNF's Trabuco Ranger District has a history of serious wildfires. Fires can be started during major construction, and high-voltage lines can create hazards to firefighters. The Forest Service has indicated a concern about fire risk related to this line segment. In addition, this segment has habitat for a number of biological species of concern.

Constraint 4: Expansion of ROW Through Camp Pendleton

The new 500 kV line following the existing Talega-Escondido corridor between Case Springs and Talega would be on land owned by Camp Pendleton. The undeveloped land in the vicinity of the ROW is used for military training and exercises but is largely undisturbed. An agreement between the Navy and SDG&E provides for use of the ROW and a portion of the Talega Substation site. The current easement document would require an amendment by the parties to expand the ROW. Concerns may arise regarding to the height and location of towers and spans relative to existing towers and spans, and the risk they may pose to military aircraft. The existing ROW grant would have to be examined to determine if a line larger than 230 kV is allowed, and if taller towers would be permitted. Additional concerns would relate to the potential for igniting a fire and for impacts on firefighting. The landscape along much of the ROW is undisturbed and has the potential to provide habitat for various special status species.

The existing ROW may not be sufficiently wide to support both the existing 230 kV and a new separate 500 kV line. If additional ROW is needed, this would have to be negotiated with the Navy.

In a preliminary rights analysis, SCE concluded that the language in its agreement allowing a ROW through Camp Pendleton "does not allow additional towers or additional lines in the existing ROW. Construction of a new 500 kV line would require an amendment or new

easement document. Even with an amendment to allow construction of a new tower, [the] current ROW is not large enough for both the existing 230 kV lines and a new 500 kV line and would require expansion."

Constraint 5: Crossing CNF Lands With Restricted Land-Use Designations

See discussion of Constraint 3 in the discussion of Alternative 2, "Use of I-15 Caltrans ROW."

Constraint 6: Scenic and Dispersed Residential Areas and Tribal Concerns in Northern San Diego County

See discussion of Constraint 4 in Alternative 2, "Scenic and dispersed residential areas and tribal concerns in northern San Diego County."

Constraint 7: Expansion of ROW Through Santa Margarita Ecological Reserve

The Case Springs-to-Inland segment may require additional ROW. Construction of the Case Springs Substation would be constrained by terrain and by access road requirements, potentially affecting Camp Pendleton or an ecological reserve. This segment passes through the Santa Margarita Ecological Reserve, most of which is in Riverside County north of the ROW. However, south of the county line, parts of the existing Talega-Escondido ROW near the Santa Margarita River fall within the Reserve boundary. Adding a new 500 kV line between Case Springs and Inland likely would require mitigation for affected special status species.

Alternative 4: Enhanced TE/VS (Talega-Serrano Route)

ALTERNATIVE 4
Enhanced TE/VS 500 kV Transmission , Option 2 (Talega-Serrano Route)

- Convert the existing Serrano–San Onofre 230 kV and Talega-Serrano 230 kV line to 500 kV line to terminate at Talega substation.
- Construct 17.6 miles of new 500 kV line from new Case Springs Substation to new Inland 500 kV Substation in northern San Diego County.
- Construct 12.4 miles of new 500 kV line from Case Springs Substation to Talega Substation on Camp Pendleton lands.
- Construct 66.7 miles of new 500 kV line from new Inland Substation to SDG&E existing Suncrest Substation; this line will be 70 percent compensated (that is, series caps are needed).
- Total new 500 kV line would be 130.8 miles long.

System Upgrades:

- Upgrade the existing Talega Substation from 230/138 kV to 500/230/138 kV.
- Construct 21.4 miles of two new 230 kV lines (double-circuit tower line) from new Inland to SDG&E's existing Escondido Substation.
- Reconfigure the existing San Onofre-Santiago (2) 230 kV lines, San Onofre-Viejo 230 kV to have these become Talega-Santiago (2), Talega-Viejo (1) 230 kV lines. The other existing lines terminating at Talega are Talega-San Onofre (3), and Talega-Capistrano 230 kV lines.
- Convert either one of San Onofre generating units to 700 MVAR synchronous condensers or install one 700 MVAR SVC to be connected to San Onofre 230 kV switchyard.
- Retain Huntington Beach Units 3 and 4 as synchronous condensers in the event that AES does not have a PPA or other means of financing to proceed with repowering of these units.
- Convert HB Units 1 and 2 to synchronous condensers in the event that AES does not have PPA or other means of financing to proceed with repowering of these units.

In terms of evaluating potential constraints, the most significant components of this alternative are:

- Conversion of the Serrano–San Onofre and San Onofre–Talega 230 kV lines to 500 kV in existing SCE ROW (The corridor between Talega and Serrano does not include an existing circuit directly between these two endpoints).

- New 500 kV transmission line connecting Talega to SDG&E's Suncrest Substation (via Case Springs site and Inland Substation).

- Expansion of Talega Substation from 230/138 kV to 500/230/138 kV.

The other components described above have no major siting or permitting challenges, so are not addressed in this report.

Alternative 4 Routing Summary

Appendix A presents details on the potential route for each alternative, including a description of the route itself and the land uses along the route. This section presents a brief overview of the route, as background for the discussion of routing constraints.

Alternative 4 is illustrated in Figure 11 on page 65 and includes 140 miles of new 500 kV transmission line. The route east and south of the Case Springs location is the same as that of Alternative 3, so is not described here. The unique portion of this route is the conversion of two existing transmission circuits (Serrano–San Onofre and San Onofre–Talega) to a new 500 kV line, terminating at Talega substation. The existing ROW between Talega and Serrano passes through the densely developed cities of San Clemente and Mission Viejo for about 5 and10 miles, respectively, before turning into the hills.

Alternative 4 Constraints

The major constraints on the Alternative 4 route are those listed below. Each constraint is described in more detail in the following paragraphs.

1. ROW across La Jolla reservation
2. Expansion of facilities in existing ROW through Mission Viejo and other cities; transmission congestion north and west of Talega Substation
3. New ROW to accommodate 500 kV and 220 kV lines terminating in Talega
4. Expansion of Talega Substation
5. Expansion of ROW through Camp Pendleton
6. Crossing CNF lands with restricted land-use designations
7. Scenic and low-density residential areas in northern San Diego County
8. Expansion of ROW through Santa Margarita Ecological Reserve

Constraint 1: ROW Across La Jolla Reservation

See discussion of Constraint 1 in Alternative 3, "ROW Across La Jolla Reservation."

Constraint 2: Expansion of Facilities in Existing ROW Through Mission Viejo and Other Cities; Transmission Congestion North and West of Talega Substation

Figure 12 on page 66 illustrates two areas of very dense residential neighborhoods through which the Talega-Serrano corridor passes. In all, four additional circuits would terminate at Talega Substation: one 500 kV and three 220 kV circuits. The existing SCE Serrano–San Onofre single-circuit 220 kV line would be replaced with a single-circuit 500 kV line between Serrano and Talega. For much of its length, the 220 kV line shares towers with SCE's 220 kV Chino-

Viejo–San Onofre line. The replacement 500 kV circuit and the Chino-Viejo–San Onofre 220 kV circuit would be accommodated on new towers built to accommodate the two lines, and the existing 220 kV towers would be removed.

Except in the immediate vicinity of the Serrano Substation, for about 17 miles east and south from the substation, much of the ROW is in open land through the Irvine Ranch Conservancy. Most of this area is designated as part of the National Natural Landmarks program. This designation is by way of voluntary agreements with the landowner(s). The existing ROW predates the designation, and the program does not appear to pose any restrictions on upgrading the existing 220 kV structures to 500/220 kV structures in the ROW.

SCE conducted a preliminary rights analysis and concluded, "The northern portion of this corridor passes through both the Irvine Ranch as well as the Cleveland National Forest. The results of a preliminary rights analysis highlighted several places along the corridor where the existing rights would be insufficient as they contain language which does not allow additional towers or circuits. These areas would require newly negotiated agreements to install or upgrade facilities."

At Mission Viejo and in the cities to the south, the ROW is used extensively for active and passive recreation and parking. Compatible uses such as ball fields, trails, parking, nurseries, and landscaping often are colocated with transmission ROWs in developed areas. New towers for the 500/220 kV circuits would be larger than the existing towers that would be removed, creating a visual impact to facility users and neighboring properties. Depending on tower spacing, reconfiguration of other uses in the ROW might be required. It its preliminary rights analysis, SCE concluded that, "The central portion of this corridor passes within less than 150 feet from numerous residential communities for several miles. Although the corridor is 200 feet wide, installation of a double circuit 500 kV tower would be significantly taller than the existing 230 kV tower and have visual impact to the residents of this area. Successful construction of underground through this area would be unlikely due to the outage requirements for the 230 kV lines which pass overhead. These facilities would need to be de-energized and temporary structures constructed in order to maintain service during the construction. Where the corridor joins with the additional 230 kV lines coming from Santiago, the ROW is not large enough for both the existing 230 kV lines and a new 500 kV line and would require expansion."

From San Juan Hills High School to Talega Substation, SCE and SDG&E have abutting ROWS. SCE's Serrano–San Onofre ROW is on the south side of the corridor, and SDG&E's ROW between Talega Substation and the utility's southern Orange County service area is on the north side. Each ROW is about 200 feet wide.

As part of its ongoing South Orange County Reliability Enhancement (SOCRE) Project, SDG&E proposes replacing a single-circuit 138 kV line in the ROW with 7.5 miles of double-circuit 230 kV line. If the existing SDG&E 69 kV circuit were placed underground, it appears that there would be sufficient corridor width to accommodate the replacement SCE 500/220 kV line.

Constraint 3: New ROW to Accommodate 500 kV and 220 kV Lines Terminating in Talega

Terminating the two San Onofre–Santiago 220 kV circuits, the San Onofre–Viejo-Chino 220 kV circuit, and the new 500 kV circuit at Talega Substation would require inserting four new circuits into the congested area immediately west of the substation and accommodating them in the substation as well.

Based on the current width of the ROWs here and the SOCRE Project, additional ROW would be needed for the addition of four SCE lines to terminate at the substation. There is vacant land both south and north of the existing corridor that could accommodate the ROW expansion. Given the variety of line crossings west of the substation, it is likely the four new terminating lines would be on the north side of the ROW in Orange County.

Constraint 4: Expansion of Talega Substation

See discussion of Constraint 2 in Alternative 3, "Expansion of Talega Substation."

Constraint 5: Expansion of ROW Through Camp Pendleton

See discussion of Constraint 4 in Alternative 3, "Expansion of ROW Through Camp Pendleton."

Constraint 6: Crossing CNF Lands With Restricted Land-Use Designations

See discussion of Constraint 5 in Alternative 3, "Crossing CNF Lands With Restricted Land-Use Designations."

Constraint 7: Scenic and Dispersed Residential Areas and Tribal Concerns in Northern San Diego County

See discussion of Constraint 6 in Alternative 3, "Scenic and Dispersed Residential Areas and Tribal Concerns in Northern San Diego County."

Constraint 8: Expansion of ROW Through Santa Margarita Ecological Reserve

See discussion of Constraint 7 in Alternative 3, "Expansion of ROW Through Santa Margarita Ecological Reserve."

Alternative 5: Imperial Valley to Inland (AC or HVDC)

ALTERNATIVE 5
San Diego High-Voltage Transmission Options 1A and 1B

Imperial Valley to Inland – Option 1A (500 kV AC)

- New proposed 500 kV AC transmission line between the existing SDG&E Imperial Valley Substation and the new SDG&E Inland Substation within northern San Diego County. This alternative is proposed as an overhead line that would be nearly 140 miles in length.
- In addition to the new transmission line, the new 500/230 kV Inland Substation would be constructed at a new north inland location, as well as the upgrade/construction of a 500/230 kV substation at the existing Imperial Valley Substation.
- The proposed option may include provisions for the installation of two 500 MVA +/- 45° phase shifters at the new SONGS Mesa 230 kV Substation (that is, expand the existing Japanese Mesa Substation) to optimize network flow through the San Diego transmission system and into the Los Angeles load center.

Imperial Valley to Inland – Option 1B (HVDC)

- New proposed HVDC transmission line between the existing SDG&E Imperial Valley Substation and the new SDG&E Inland Substation within northern San Diego County. This alternative is proposed as an overhead and underground line that would be roughly 142.2 miles in length, with an underground segment of 36.3 miles.
- In addition to the new transmission line, the new Inland Substation would be constructed at a new north inland location as well as the installation of DC converter stations at this new substation and the existing SDG&E Imperial Valley Substation. This project will include provisions for integrating the proposed DC terminal at Imperial Valley with a DC flow control device to improve network flow across the ISO, IID, and CFE transmission systems.

System Upgrades for Both Options 1A and 1B

- Reconductor Escondido-Talega transmission line (TL 23030) to a minimum rating of 1175/1175 MVA normal/emergency and loop-in to the new Inland Substation. Construct a new 230 kV transmission line on the vacant side of the existing tower line supporting TL 23030 between Escondido and Talega Substations and loop-in to the new Inland Substation.

This alternative is described in two parts. The first section below presents Imperial Valley to Inland, Option 1A (500 kV AC), and the second section presents Option 1B (HVDC, overhead and underground). For each option, the major component addressed is the proposed new transmission line between the Imperial Valley Substation (Imperial County) and the new Inland Substation (northern San Diego County).

Appendix A presents details on the potential route for each alternative, including a description of the route itself and the land uses along the route. This section presents a brief overview of the route, as background for the discussion of routing constraints.

Imperial Valley to Inland, Option 1A (500 kV)

Figure 13, Alternative 5, on page 67 illustrates a potential route for this 500 kV line. The potential route is assumed to be all overhead. It follows much of the originally proposed 500 kV Sunrise Powerlink Transmission Project, combined with the SDG&E "500 kV Full Loop" proposed during the Sunrise proceeding. This route is not considered likely to be feasibly permitted, as described in the section below on constraints. However, it is described briefly here to illustrate the challenges of crossing ABDSP.

Imperial Valley to Inland, Option 1A: Routing Summary

In Chapter 1, the section "Anza-Borrego Desert State Park" describes three possible routes for crossing ABDSP. This alternative follows the existing 69/92 kV transmission lines through the park. Starting from the Imperial Valley Substation, the route follows the originally proposed Sunrise Powerlink route north through Imperial County, then west along Highway 78 into ABDSP.

Upon leaving the park at its western boundary, the potential route would diverge from the Sunrise route and instead would follow the Highway 76 route defined by SDG&E's "500 kV Full Loop." This route segment in northern San Diego County is common with that described for Alternatives 3 and 4. When the route meets the Talega-Escondido corridor (just north of the Lilac Substation), the 500 kV line would turn north and parallel the Talega-Escondido line (in new ROW) to the Inland Substation.

Imperial Valley to Inland, Option 1A: Constraints

The major constraints on the Alternative 5, Option 1A route are those listed below. Each constraint is described in more detail in the following paragraphs.

1. Overhead passage through Anza-Borrego Desert State Park
2. Inadequate ROW through ABDSP Wilderness
3. Passing through Angelina Spring Cultural Preserve area and potential direct and indirect effects on numerous cultural resources
4. Diminishing the recreational and scenic value of ABDSP
5. ROW across La Jolla reservation
6. Scenic and low-density residential areas in northern San Diego County

Constraint 1: Overhead Passage Through Anza-Borrego Desert State Park

As documented extensively in the Sunrise Powerlink EIR/EIS, an overhead 500 kV line through ABDSP would result in numerous significant and unmitigable impacts and very substantial opposition from the State Parks Department, members of the public, and organizations. The most important impacts would result from the following concerns:

- Loss of visual quality in and around ABDSP's central and heavily visited scenic region and designated wilderness areas.
- Effects on desert bighorn sheep and numerous other sensitive species.
- Construction noise and traffic.
- Corona noise in remote and quiet areas.

Constraint 2: Inadequate ROW Through ABDSP Wilderness

The required ROW width is not available through Grapevine Canyon between two ABDSP wilderness areas. Therefore, the State Parks Commission would have to reverse the wilderness designation of a segment along the ROW for the State Parks Department to permit the transmission project.

Constraint 3: Passing Through Angelina Spring Cultural Preserve and Potential Direct and Indirect Effects on Numerous Cultural Resources

In 2012, park officials completed their review of the valuable cultural zones and designated several of them as "cultural preserves." One of these, Angelina Spring, is traversed by the existing 69 kV line through Grapevine Canyon. This new designation as a preserve presents an additional reason for the infeasibility of an overhead route through the park.

According to the 2012 *Anza-Borrego Desert State Park Cultural Preserve Management Plan,*[1]

> A cultural preserve is an internal unit of an existing State Park, State Recreation Area or State Vehicle Recreation Area. It is a delineated zone where the primary goal is for focused management based on preservation. These designations incorporate park lands that contain rich and outstanding prehistoric and historic resources which include archaeological sites, village locations, burial grounds, rock art panels, trails, ranches, structures and cultural landscapes.[2]

The Legislature provided for the cultural preserve subclassification in the Public Resource Code:

> Cultural Preserves consist of distinct non-marine areas of outstanding cultural interest established within the boundaries of other state park system units for the purpose of protecting such features as sites, buildings, or zones which represent significant places or events in the flow of human experiences in California. Areas set aside as cultural preserves shall be large enough to provide for the effective management and interpretation of the resources. **Within cultural preserves, complete integrity of the cultural resources shall be**

1. http://www.parks.ca.gov/pages/21299/files/FINAL_ABDSP_Cultural_Preserve_Management_Plan_112612.pdf

sought, and no structures or improvements that conflict with the integrity shall be permitted." (P.R.C. 5019.74; emphasis added)

Constraint 4: Diminishing the Recreational and Scenic Value of ABDSP

Based on detailed comments provided by officials of the ABDSP and the State Parks Department on the proposed Sunrise Powerlink Project and the route through ABDSP, a 500 kV transmission line along Highway 78 and through Grapevine Canyon would have severe adverse effects on the use and value of the park. The EIR/EIS for the Sunrise Powerlink also identified significant and unmitigable visual and recreational impacts.

Constraint 5: ROW Across La Jolla Reservation

See discussion of Constraint 1 for Alternative 3, "ROW Across La Jolla reservation."

Constraint 6: Scenic and Dispersed Residential Areas and Tribal Concerns in northern San Diego County

See discussion of Constraint 4 for Alternative 2, "Scenic and Dispersed Residential Areas and Tribal Concerns in Northern San Diego County."

Imperial Valley to Inland, Option 1B (HVDC)

As illustrated in Figure 14, Alternative 5, Option 1B has the same substation endpoints as Alternative 5, Option 1A, but is an HVDC alternative, so it can more easily be installed underground. See Appendix C on ROW requirements for AC and DC transmission lines. Because this option is an HVDC line, it would require construction of AC/DC converter stations at the Imperial Valley and Inland Substations. The potential route for Alternative 5, Option 1B is illustrated in Figure 14 on page 68.

Imperial Valley to Inland, Option 1B: Routing Summary

The route of Option 1B is very similar to that described in Option 1A except that this option is suggested to be installed underground through ABDSP, within the ROW of Highway 78. Because this is not a controlled-access highway, the Caltrans restrictions described in Alternative 2, Constraint 2 ("Use of I-15 Caltrans ROW") would not be applicable.

This all-underground option was studied and found to be feasible in the Sunrise Powerlink EIR/EIS. It was considered because it would eliminate the visual impacts in the park of the overhead transmission line, it would eliminate corona noise, and it would avoid the Angelina Spring Cultural Preserve.

Imperial Valley to Inland, Option 1B: Constraints

While an underground line would not be visible, there remain several challenges and constraints to installation of an underground line, even HVDC, through the park. The major constraints on the Alternative 5, Option 1B route are those listed below. Each constraint is described in more detail in the following paragraphs.

1. Construction disturbance and traffic obstruction through Anza-Borrego Desert State Park.

2. Construction challenges related to bedrock and crossing of the Earthquake Valley Fault.

3. Disturbance of desert bighorn sheep and likely seasonal construction constraints.

4. ROW across La Jolla reservation.

5. Scenic and low-density residential areas in northern San Diego County.

Constraint 1: Construction Disturbance and Traffic Obstruction Through Anza-Borrego Desert State Park

While this route would be entirely underground within ABDSP, the construction within the narrow and winding Highway 78 would likely require road closures. With Highway 78 closed, access between the Imperial Valley and northern San Diego County would be extremely time-consuming. Construction would likely require blasting to construct the trench in bedrock, so construction noise within the park would be severe.

Constraint 2: Construction Challenges Related to Bedrock and Crossing of the Earthquake Valley Fault

This option would cross the Earthquake Valley Fault and would parallel the fault for several miles along County Highway S2. The crossing of major faults is not recommended for high-voltage transmission lines when installed underground, due to the risk of cable rupture and the time required for repair. However, due to the extremely high value of the protected open space in ABDSP and the San Felipe Valley, and the unknown frequency of major earthquakes in this area (likely substantially less frequent than once in 100 years), the underground line is considered to be feasible and a worthwhile trade-off for elimination of visual and other severe impacts.

Construction in County Highway S2 would be likely feasible, but State Route (SR) 78 is narrow (as narrow as 23 feet in width) and winding with rocky slopes on both sides of the roadway. This would make construction challenging and costly in this portion, but it is likely to be feasible. A job hazard analysis prior to the start of construction would be required to evaluate the risk of falling rock due to vibration from construction equipment. The job hazard analysis would identify the hazard and would propose solutions to mitigate or eliminate the risk of falling rocks.

Constraint 3: Disturbance of Desert Bighorn Sheep and Likely Seasonal Construction Constraints

This route through the park passes through a significant population of desert bighorn sheep. The sheep are protected during their lambing season, so construction would likely be prohibited during this season. Other seasonal constraints on construction may also be imposed for different species or during major park visitation periods. This could result in an extremely long construction time frame.

Constraint 4: ROW Across La Jolla Reservation

See discussion of Constraint 1 for Alternative 3 (“ROW Across La Jolla Reservation”).

Constraint 5: Scenic and Dispersed Residential Areas and Tribal Concerns in Northern San Diego County

See discussion of Constraint 4 for Alternative 2 ("Scenic and Dispersed Residential Areas and Tribal Concerns in Northern San Diego County").

Alternative 6: Valley to Inland (AC or HVDC)

ALTERNATIVE 6
San Diego High-Voltage Transmission Options 2A and 2B

- **Valley–Inland, Option 2A (500 kV AC)** – New proposed 500 kV AC transmission line between the existing SCE Valley Substation and the new SDG&E Inland Substation within northern San Diego County. This alternative is proposed as an overhead line that would be roughly 40 miles in length. In addition to the new transmission line, the new 500/230 kV Inland Substation would be constructed at a new north inland location. The proposed option may include provisions for the installation of two 500 MVA ±45° phase shifters at the SONGS Mesa 230 kV substation to improve network flow through the San Diego transmission system and into the Los Angeles load center.
- **Valley–Inland, Option 2B (HVDC)** – New proposed underground HVDC transmission line between the existing SCE Valley Substation and the new SDG&E Inland Substation within northern San Diego County. This alternative is proposed as an underground line that would be about 30 miles in length. In addition to the new transmission line, the new Inland Substation would be constructed at a new north inland location, as well as the installation of DC converter stations at this new substation and the existing SCE Valley Substation.

System Upgrades for Both Options 2A and 2B

- Reconductor TL 23030 (Escondido-Talega) to a minimum rating of 1175/1175 MVA normal/emergency and loop-in to the new Inland Substation. Construct a new 230 kV transmission line on the vacant side of the existing tower line supporting TL 23030 between Escondido and Talega Substations and loop-in to the new Inland Substation.

This alternative is described in two parts. The first section presents Valley to Inland, Option 2A (500 kV AC), and the second section presents Option 2B (HVDC underground). The system upgrades (Reconductor Escondido-Talega) are described for Alternatives 2, 3, and 4 above and present no significant constraints. The major components analyzed here are:

- New transmission line routes between Valley Substation and a new Inland Substation.
- Expansion of Valley Substation for DC Converter Station or additional 500 kV connection.

Valley Substation and the proposed Inland Substation sites are about 22 miles apart, as the crow flies. There is no existing high-voltage transmission between these two substations. The Valley Substation is located at the intersection of Menifee Road and State Route 74 in Menifee,

Riverside County. The Inland Substation would be located on undeveloped land near Rainbow Heights Road in unincorporated San Diego County, just south of the San Diego-Riverside County border.

Appendix A presents details on the potential route for each alternative, including a description of the route itself and the land uses along the route. This section presents a brief overview of the route as background for the discussion of routing constraints.

Valley to Inland, Option 2A (500 kV AC)

Valley to Inland, Option 2A: Routing Summary

The Valley-to-Inland area is heavily constrained by existing homes. While it would be theoretically possible to design a 200-foot ROW between these two substations, the route would be located immediately adjacent to existing homes and follow an existing bike path and levee to avoid the take of existing homes.

A new overhead 500 kV transmission line would require a new 200-foot ROW; however, for this study the authors considered corridors that would be wider than 200 feet whenever possible to provide flexibility for siting should it be needed. The overhead route described here and illustrated in Figure 15 is considered very likely to be infeasible, due to the density of existing development in the area and the lack of existing transmission corridors. However, a route is described here that would like present the least constraints possible.

The potential Valley-Inland overhead route would exit the Valley Substation to the southeast, make a wide eastward loop around the cities of Menifee, Murrieta, and Temecula before turning west toward the I-215 freeway north of the Pechanga Indian reservation and the Agua Tibia Wilderness. It would then parallel the freeway south to the Talega-Escondido transmission corridor and turn east to follow that corridor to the Inland Substation location. To avoid the constraints outlined above, the potential Valley-Inland route would remain entirely east of the I-215 and I-15 freeways.

Direct Overhead Route: Considered but Eliminated. The most direct route between the Valley and Inland Substations would parallel the I-215 freeway, cross the freeway into the City of Murrieta and arrive at the Inland Substation from the west. This route would be 10 miles shorter than the potential route but was eliminated from consideration for the following reasons:

- The route would be located within less than 200 feet from homes for several miles and near several existing schools.
- The route would be located in a riparian corridor for 3 miles to avoid homes.
- The route would have to run directly over existing commercial and industrial development or require the removal of several existing buildings.

- The route would cross the Santa Margarita Ecological Reserve. The 4,344-acre reserve is a field station for San Diego State University and provides protected sites for research and education of Southern California ecosystems (San Diego State University, 2013). The BLM manages 1,247 acres of the reserve as an Area of Critical Environmental Concern (ACEC), and portions of the Santa Margarita River within the ACEC are eligible for classification as a "wild river," the most restrictive of the Wild and Scenic River classification (U.S. Bureau of Land Management, 2012).

Valley to Inland, Option 2A: Constraints

The major constraints on the Alternative 6, Option 2A route are those listed below. Each constraint is described in more detail in the following paragraphs.

1. Pechanga reservation
2. Agua Tibia Wilderness
3. Density of residential and commercial development
4. Southwestern Riverside County Multiple Species Core Reserve
5. Temecula Bike Path

Constraint 1: Pechanga Reservation

The potential route completely avoids tribal land of the Pechanga reservation because this tribe's land acquisition 10 years ago effectively prevented the development of a viable Valley-Rainbow transmission line route. The Pechanga Indian reservation is east of the I-15 corridor and extends roughly six miles east to west. During the evaluation of the Valley-Rainbow 500 kV Interconnect Project, the Pechanga Band of Luiseño Mission Indians stated that consent must be given to have access to their lands for any environmental study or for any proposed route through the reservation (California Public Utilities Commission, 2001). The Nation of the Pechanga Band of Luiseño Mission Indians did not give its consent for a route through the Pechanga Indian reservation, and there is no indication that it would do so at this time (California Public Utilities Commission, 2001). As such, the route avoided the Pechanga Indian reservation to avoid feasibility constraints.

Constraint 2: Agua Tibia Wilderness

The potential route avoids the Cleveland National Forest Agua Tibia Wilderness, which is located immediately east of the Pechanga Indian reservation. This area extends about 4.8 miles eastward. A transmission corridor would not be compatible with wilderness lands, so the constraint has been avoided.

Constraint 3: Density of Residential and Commercial Development

The result of the avoidance of both the Pechanga reservation and the Agua Tibia Wilderness is that the potential route must jog west just north of those two jurisdictions, passing through central Temecula along a route that is not likely to be permittable.

As can be seen in the route presented in Figure 15, the potential route includes a broad sweep around the eastern side of the Menifee/Temecula area to avoid as many homes as possible. However, even with that routing, the potential route would affect many locations between the Valley and Inland Substations that are heavily developed with suburban homes, especially near the boundary between Menifee and Temecula. In addition, numerous rural residential areas are located outside Temecula, further complicating the corridor route. Portions of the potential route have sufficient land available to accommodate a 500 kV line ROW, but some locations would require the corridor to be within 150 feet of homes.

Constraint 4: Southwestern Riverside County Multiple Species Core Reserve

The corridor would potentially conflict with the Southwest Riverside County Multi-Species Reserve. A route through the reserve would require approval from the Reserve Management Committee made up of the Metropolitan Water District (MWD), Riverside County Habitat Conservation Agency, U.S. Fish and Wildlife Service (USFWS), the California Department of Fish and Wildlife (CDFW), and Riverside County Regional Parks and Open Space District. Ten local government agencies have permits that rely on the integrity of the reserve. Regulatory feasibility, as well as environmental criteria, depends on whether a new 500 kV line would jeopardize permits in place.

Constraint 5: Temecula Bike Path

To traverse Temecula and avoid take of any residential or commercial development, the route would follow an existing bike path along a riparian area. This riparian corridor is about 500 feet wide and could technically accommodate a 200-foot ROW. The potential route would require removal of some existing riparian vegetation and would conflict with the existing bike path use.

Valley to Inland, Option 2B (HVDC Underground)

Valley to Inland, Option 2B: Routing Summary

The Valley-to-Inland underground HVDC transmission line between the existing SCE Valley Substation and the new SDG&E Inland Substation would be underground within existing roads. The permanent access right-of-way requirements for an underground HVDC route would be about 13 feet (TransÉnergieUS, 2004). As described in Appendix C (ROW Requirements), construction of an underground HVDC would require an underground duct bank roughly 2 feet wide and buried at least 3 feet deep. Larger vaults would be located along the route at nearly 1,600 feet apart.

All underground construction of transmission lines requires a continuous trench in which to install duct banks that would carry the electrical cables. If not constructed with appropriate best management practices, this amount of trenching could create soil erosion and could affect buried cultural or paleontological resources. To minimize other effects on natural resources, the potential route would follow existing roads from Valley Substation until a point about 2 miles west of the new Inland Substation. This southernmost 2-mile stretch is essentially roadless, and it is the route of the existing Talega-Escondido 230 kV transmission line, so in this segment, the route would transition to overhead until reaching the Inland Substation.

Substation Expansion for Converter Station

The HVDC route would require two AC/DC converter stations: one at the Valley Substation and one at the Inland Substation. The converter stations would require 5 acres of land. At both the Valley Substation and the proposed Inland Substation, there is sufficient vacant land such that 5 acres would be available for construction of the converter stations. Near the Valley Substation, the available land is existing agriculture. Near the proposed Inland Substation, the land is either undeveloped or open space.

Valley to Inland, Option 2B: Constraints

The major constraints on the Alternative 6, Option 2B route are those listed below. Because the HVDC underground route would follow existing roads, it would be less constrained by adjacent land uses or natural resources that would be affected by an overhead line in undisturbed areas. Each constraint is described in more detail in the following paragraphs.

1. Existing utilities in the road ROW
2. Engineering considerations
3. Electric and magnetic fields

Constraint 1: Existing Utilities Within the Road ROW

The underground HVDC construction ROW would require about 13 feet of space parallel to the trench, but the trench itself would be only about 3 to 6 feet wide. In some instances, roadways, in particular older roadways, may be congested due to existing utilities located beneath the surface. For example, while much of the underground route has distribution facilities above ground, some of the newer development may require distribution lines to be underground. Typical underground utilities include water lines, sewer pipes, and natural gas pipelines.

Separation from existing utilities would be required to ensure safety of all utilities during both construction and operation.

Constraint 2: Engineering Considerations

The HVDC route follows straight roads wherever possible as this would ease the construction of an underground road where trenching is required. The bending radius for underground cables and vaults along this route would need to be carefully engineered, in particular in locations where the road width is limited. Special construction methods (horizontal boring and/or directional drilling) may be required in areas where open trench construction is not feasible. These areas would include railroad tracks (such as along Case Road), large utility crossings, roads, drainage crossings, and environmentally sensitive areas.

Constraint 3: Electric and Magnetic Fields

The Chapter 1 section, "Electric and Magnetic Fields from Transmission Lines and Potential Health Concerns," describes EMF as one of the potential concerns about underground transmission lines. In some projects that undergo substantial public scrutiny, especially where the lines would be located near homes, a major issue of concern tends to be regarding potential

health effects from exposure to electric and magnetic fields (EMFs). Generally, providing information and educational materials on these fields can resolve many concerns.

There are three primary electrical parameters associated with the environment in the vicinity of HVDC transmission lines: 1) the electric field, 2) the magnetic field and 3) air ions.

- Both HVAC and HVDC lines generate electric fields surrounding the conductors, with the magnitude of the electric field dependent on the voltage of the line. The strength of the static electric field decreases rapidly with distance from the source. Electric fields are shielded by trees, walls, or other objects and, if shielded, do not penetrate the body. Adverse health effects have not been scientifically established.

- Both HVAC and HVDC lines generate magnetic fields. The magnetic field for a DC line is a static field that does not change over time, much like the Earth's magnetic field. Static magnetic fields have been studied extensively at strengths significantly higher than for HVDC transmission lines due to their use in medical diagnostics. Studies found no significant increase or decrease in the prevalence of the diseases evaluated, and the data do not allow a conclusion that exposure to DC magnetic fields affects health.

- *Air ions* are charged air molecules produced by corona, the partial electrical breakdown of the air surrounding conductors. A result of corona is both positive air ions that have lost an electron and negative air ions that have picked up the excess electrons. For HVDC lines air ions with the same polarity of the conductor migrate toward the opposite pole of the HVDC circuit, and a significant portion of the air ions migrate to the ground and away from the transmission line. Natural background air ion densities range from 1,000 ions per cubic centimeter in open areas to 80,000 ions per cubic centimeter in urban areas. Directly below HVDC transmission lines air ion densities are in the range of 100,000 ions per centimeter. Air ions have been studied for more than a hundred years; research has not provided any reliable evidence that air ions produce any harmful effects.

Alternative 7: Imperial Valley Substation Expansion

ALTERNATIVE 7
Imperial Valley Expansion
High-Voltage Flow Control Between ISO Balancing Authority Area (BAA) to Other BAAs

- Expand the existing Imperial Valley 500/230 kV Substation to accommodate the following installations:
  - Back-to-back DC installation that includes AC-DC and DC-AC converters
  - Additional 230 kV bus structure to relocate and connect 230 kV lines to IID and Comisión Federal de Electricidad in Mexico.

Alternative 7 would expand the Imperial Valley Substation to include infrastructure that would improve the flow control between the California ISO and other balancing authority areas (such as IID and Mexico). The converter stations would facilitate grid stabilization between the United States and Mexican grid systems. Assuming use of the latest technology of voltage-source converters, the footprint for a single converter station is roughly 4 acres. Because the 4 acres includes the footprint of the AC substation yard and infrastructure, around 1.5 to 2 acres would be required to incorporate the converter into an existing AC substation, such as the Imperial Valley Substation. The back-to-back converters described in this alternative would require 3 to 4 acres total.

Because the existing Imperial Valley Substation includes numerous facilities, it is unlikely that two converter buildings could be located within the existing fence line, and an expansion of the fence line is likely required. There is sufficient undisturbed land surrounding the Imperial Valley Substation that could potentially be used to expand the substation; however, several projects have been proposed that could preclude use of some of this area. The projects include the Ocotillo Sol solar PV farm, located on 100 acres immediately south of the substation, and the IID Liebert Substation, located 400 feet north of the substation. Several existing transmission lines run east of the Imperial Valley substation connecting the substation with power generation in Mexico.

Existing agriculture lands are located nearly 1,800 feet north of the substation. Locating the converters at this distance from the existing substation would likely not be feasible because the converters would need to be connected to the HVAC buses in the existing Imperial Valley Substation. However, it may be possible to build the HVAC buses as overhead transmission lines across the 1,800 feet to reach the converter stations.

Description of Existing Imperial Valley Substation

The Imperial Valley Substation is an existing major substation that serves SDG&E, IID, and merchant generators and provides an intertie to the Comisión Federal de Electricidad in Mexico. The lines served by this substation include the 500 kV SWPL and the 500 kV Sunrise Powerlink, two 230 kV interties with generators at Mexicali and Rosita to the south and an interconnection with the IID transmission system. It is located on 64 acres on BLM-administered land.

Imperial Valley Substation – Regulatory Setting

The Imperial Valley Substation is located on BLM-administered lands in Imperial County in an area identified as Limited Use by the California Desert Conservation Area Plan. Under this classification, electrical infrastructure is an allowed use in designated utility corridors. The Imperial Valley Substation is located within the BLM Utility Corridor "N."

The substation is also located within the boundaries of the BLM's Yuha Basin Area of Critical Environmental Concern (ACEC) and within the Yuha Desert Management Area for the flat-tailed horned lizard. The Yuha Basin ACEC was designated to provide protection to unique cultural and natural resources in the region, including the flat-tailed horned lizard, prehistoric resources, and historical resources (U.S. Bureau of Land Management, 2013). The Yuha Desert

Management Framework Plan contains an energy- and transmission-related goal and action; the action is to permit the traversing of the ACEC by proposed lines and associated facilities if environmental analysis demonstrates that it is environmentally sound to do so.

The nearest location outside the Yuha Desert Wildlife Management Area is existing agriculture land 1,800 feet north of the substation. Parcel APN 051 350 010 is 1.5 acres, and APN 051 350 011 is 3.6 acres. Both are zoned A-3, heavy agriculture.

Constraints to Expansion of Imperial Valley Substation

Expansion of the substation would require BLM approval with respect to two resource concerns, each described in more detail below.

1. Flat-tailed horned lizard habitat
2. Yuha Desert Wildlife Management Area

Constraint 1: Flat-Tailed Horned Lizard Habitat

The *Flat-tailed Horned Lizard Rangewide Management Strategy, 2003 Revisions: An Arizona-California Conservation Strategy* encourages surface-disturbing projects to be sited outside flat-tailed horned lizard management areas whenever possible but does not preclude such projects. If a project must be sited within a management area, the BLM encourages projects to be sited in a previously disturbed area or in an area where the habitat quality is poor and construction could be timed to minimize potential mortality. New ROW may be permitted along the boundaries of the management area, but only if impacts can be mitigated to avoid long-term effects and if the cumulative disturbance area per management area from all projects does not exceed 1 percent.

Constraint 2: Yuha Desert Wildlife Management Area

The Yuha Desert Wildlife Management Area is 57,304 acres. A 1 percent disturbance cap would comprise 573.04 acres. According to the BLM, as of July 2013, almost two-thirds of the 1 percent habitat disturbance allowance had been accounted for either through existing or authorized projects (167 acres) or proposed projects (207.6 acres) (U.S. Bureau of Land Management, 2013). As such, while not encouraged, additional disturbance could be approved by the BLM in the Yuha Desert Wildlife Management Area. Appropriate mitigation would be required, as calculated using the Flat-tailed Horned Lizard Rangewide Management Strategy formula that considers adjacent habitat impacts, growth-inducing effects, existing disturbance on site, and the duration of effects.

Alternative 8: Mesa Substation Loop-In

ALTERNATIVE 8
Transmission Upgrade Option in the LA Basin – Mesa Substation Loop-In Transmission Project

- Expand SCE's existing Mesa 230/66/16 kV Substation to include 500 kV service.
- Include three 500/230 kV and four 230/66 kV transformer banks.
- Loop in the new Vincent–Mira Loma 500 kV line (part of Tehachapi Renewable Transmission Project, scheduled to be in service in 2015).
- Loop in existing Laguna Bell–Rio Hondo 230 kV, and Goodrich–Laguna Bell 230 kV lines into the expanded Mesa Substation.

This proposed alternative includes three 500/230 kV transformer banks (bays), four 230/66 kV transformer banks (bays), and other line routing and rework. It is assumed that most of this work would require an expansion to the existing Mesa Substation facility. SCE stated that it anticipated a Mesa 500/230/66/16 kV Substation would require roughly 70 acres of land (Southern California Edison Company, 2013).

Description of Existing Mesa Substation

The 220/66/16 kV Mesa Substation is located on 23 acres. It was upgraded as a part of the Tehachapi Renewable Transmission Project with 12 new foundations for 220 kV circuit breakers and disconnect switches. Some existing 220 kV lines were relocated as part of the project. An approximately 19-acre laydown yard was constructed on a separately fenced portion of SCE property immediately southwest of the Mesa Substation.

Land Uses Around Mesa Substation

The Mesa Substation is located on land designated as general commercial in the *Los Angeles General Plan*.[3] The surrounding land uses are also identified as general commercial with some residential land uses further away. Nineteen acres of land southwest of the Mesa Substation is being used as a laydown area for the Tehachapi Renewable Transmission Project but could potentially be used for substation expansion. SCE also owns about 27 acres of land southeast of the Mesa Substation.

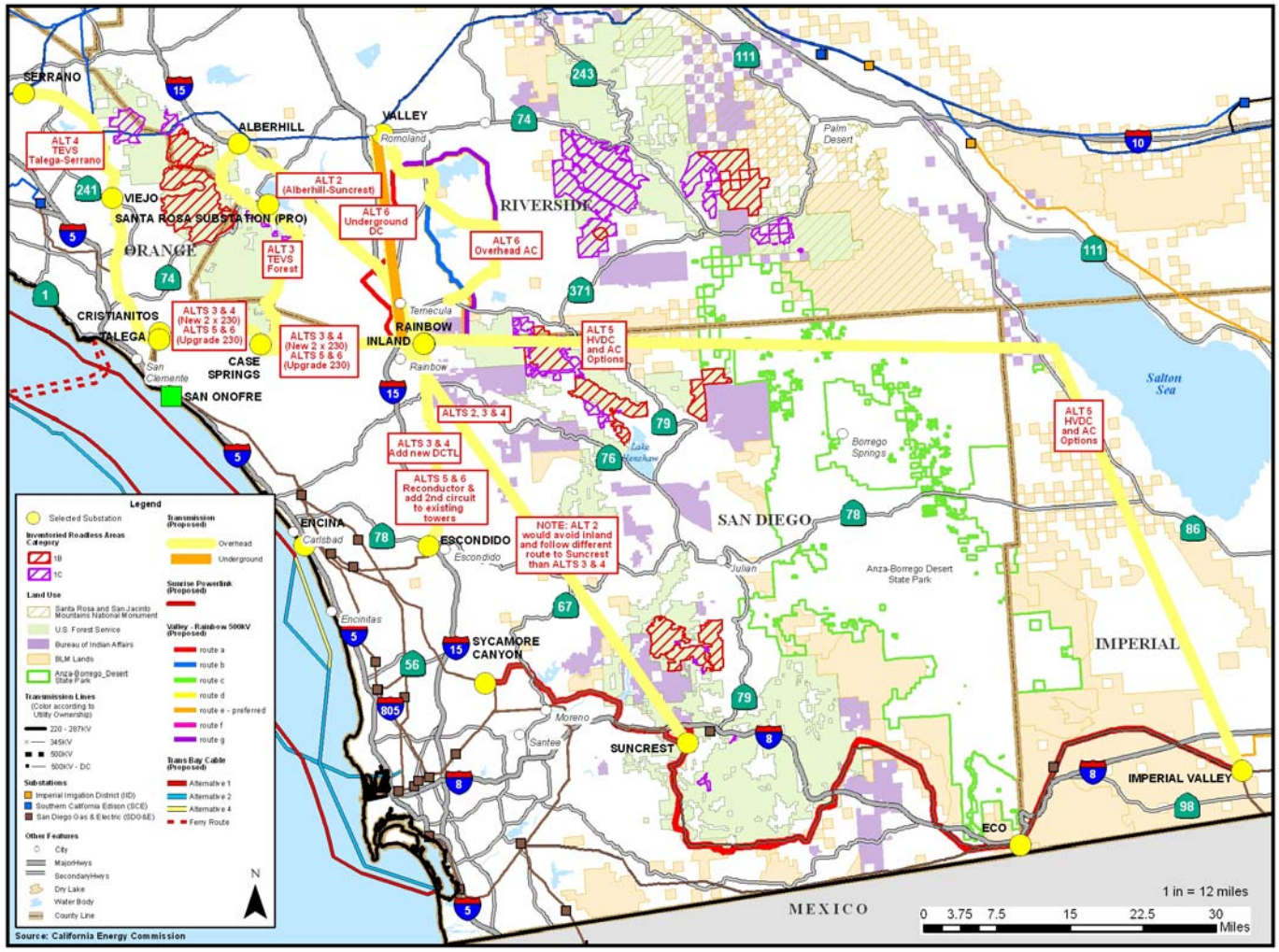
Constraints to Expansion of Mesa Substation

According to SCE, there is sufficient land available to expand the Mesa Substation (Southern California Edison Company, 2013). The land to the southwest of the substation is a laydown area, and SCE could expand the substation on this parcel. There are multiple existing transmission lines that would potentially be realigned to accommodate this expansion.

3. Los Angeles General Plan, <http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/cdd/cdcaplan.Par.15259.File.dat/CA_Desert_.pdf>

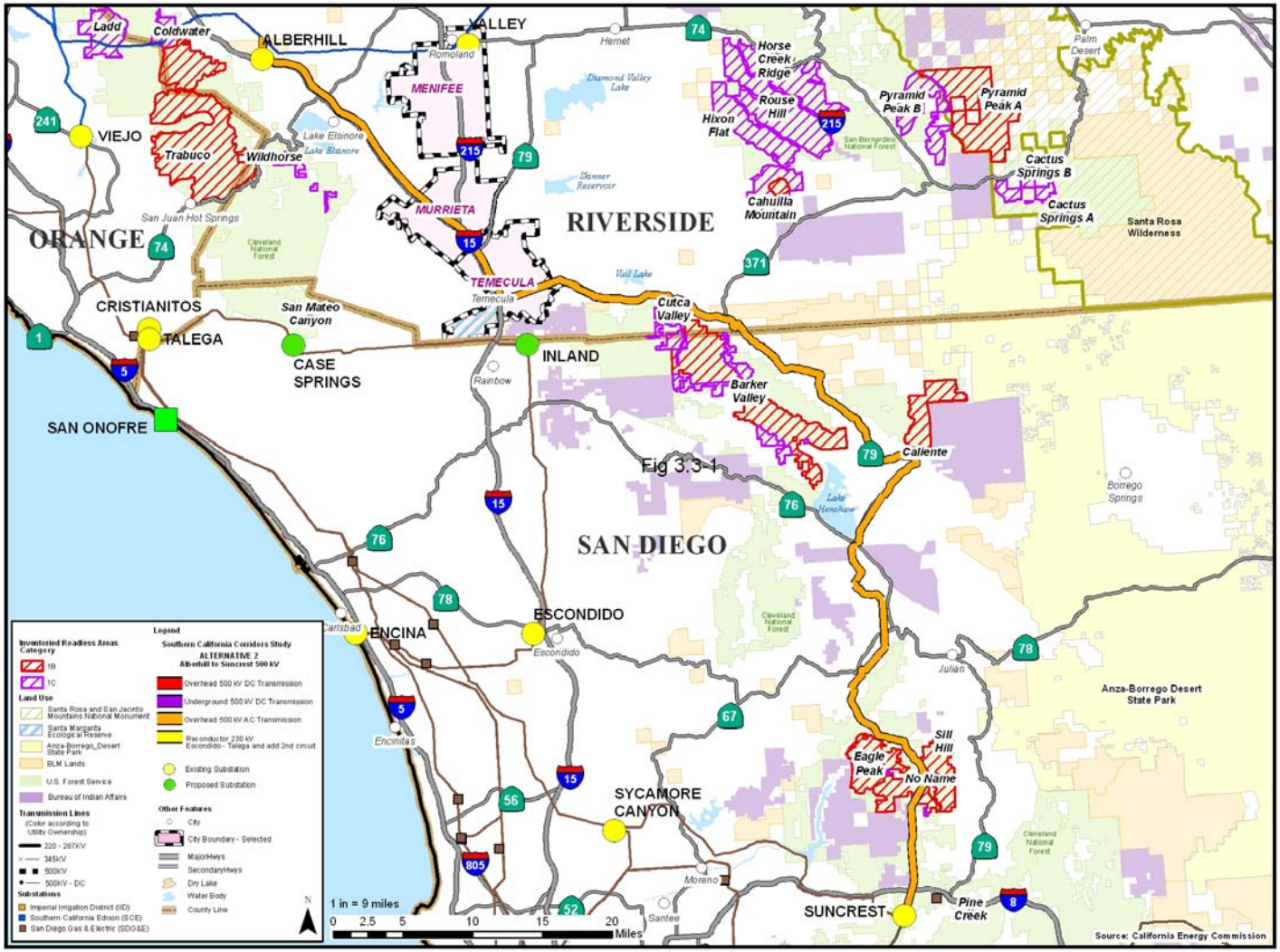
The 27-acre parcel of land located to the southeast of the Mesa Substation is an undeveloped area owned by SCE. The substation could also expand onto this parcel of land. California gnatcatcher nests were present at the 27-acre parcel during construction of the Tehachapi Renewable Transmission Project, and expansion onto this site would require mitigation for impact to the species. There are multiple existing transmission lines that would potentially be realigned to accommodate this expansion.

Figure 7: Schematic Map of Onshore Substations and Segments



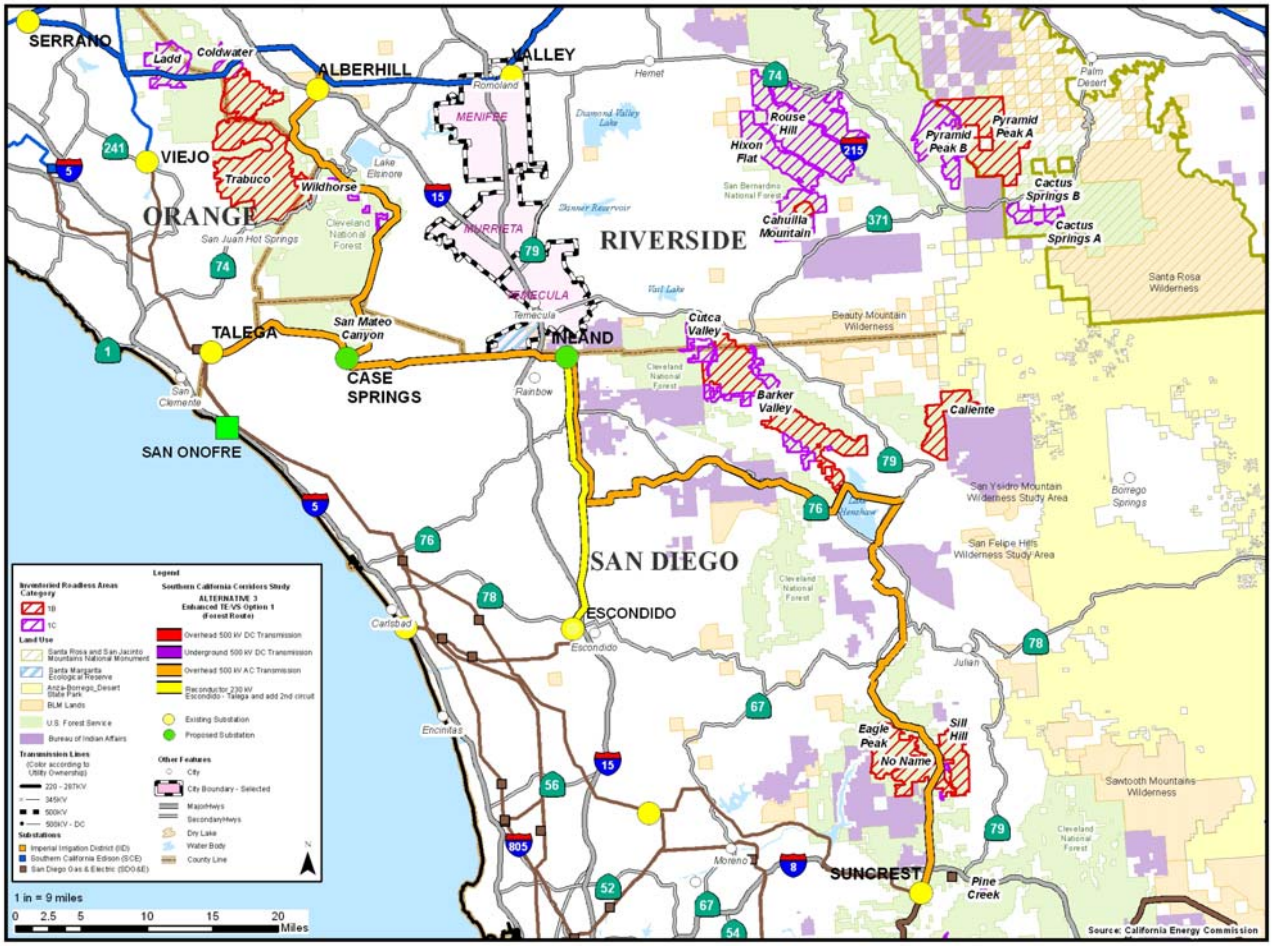
Source: California Energy Commission, 2014

Figure 8: Alternative 2 (Alberhill to Suncrest)



Source: California Energy Commission, 2014

Figure 9: Alternative 3 (Enhanced TE/VS, Forest Route)



Source: California Energy Commission, 2014

Figure 10: Talega Substation

Talega Substation - Talega Substation Topography

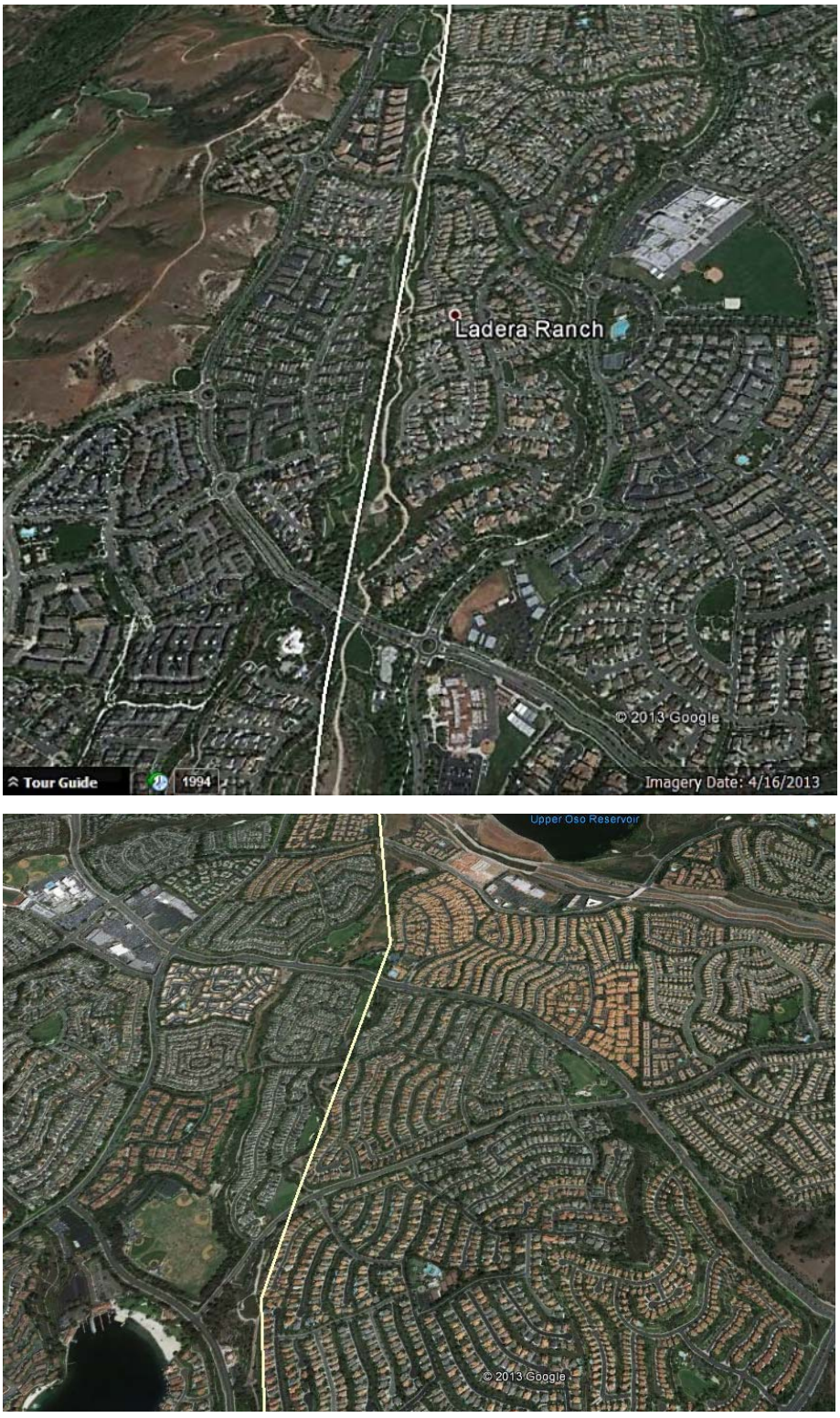
Talega Substation – Aerial Photo

Source: Obtained from Google Earth

Figure 11: Alternative 4 (Enhanced TE/VS, Tallega-Serrano Route)

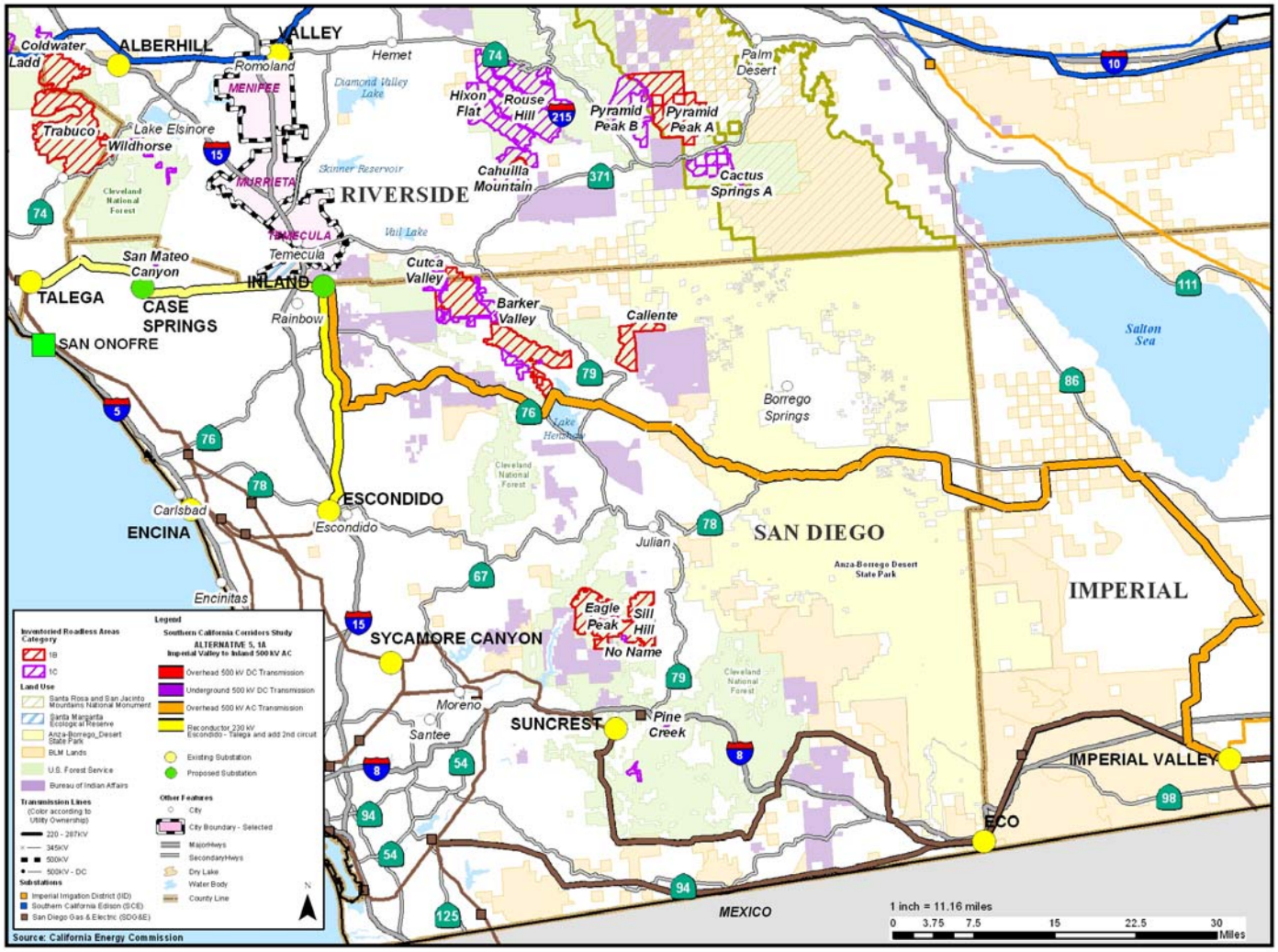
Source: California Energy Commission, 2014

Figure 12: Detail of Talega-Serrano Corridor Through Mission Viejo



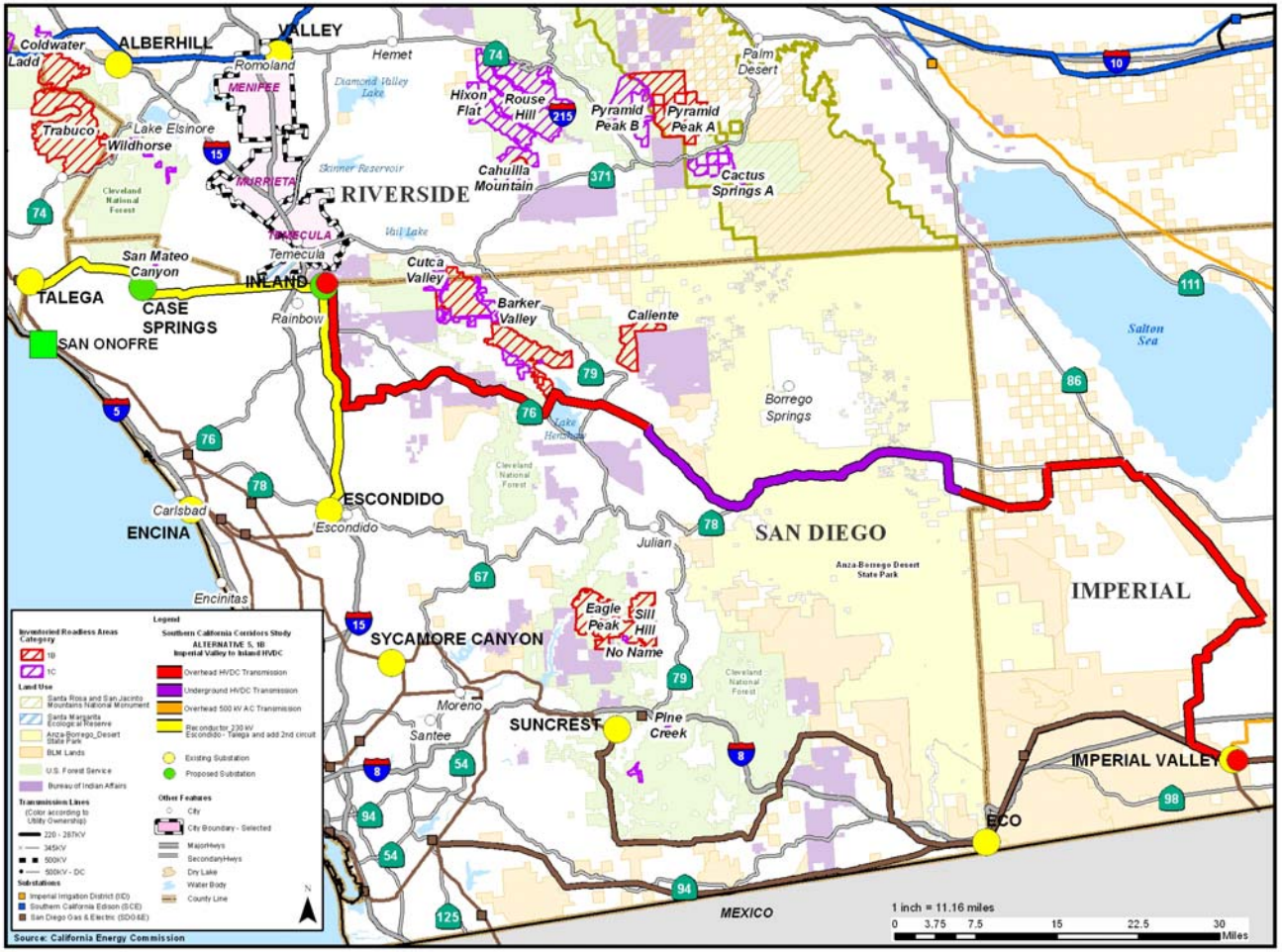
Source: Obtained from Google Earth

Figure 13: Alternative 5, Option 1A (Imperial Valley to Inland, 500 kV Overhead)



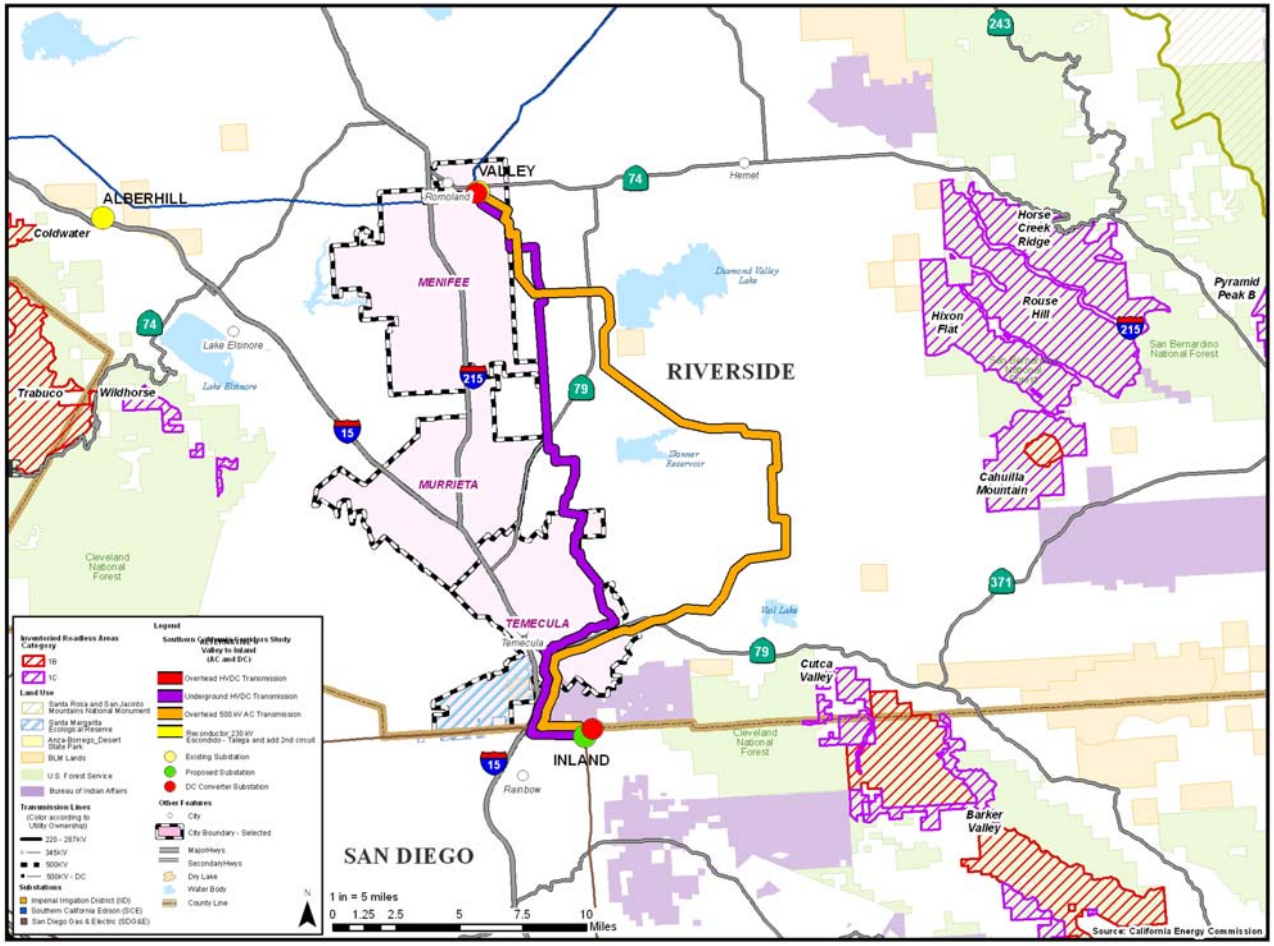
Source: California Energy Commission, 2014

Figure 14: Alternative 5, Option 1B (HVDC Overhead and Underground)



Source: California Energy Commission, 2014

Figure 15: Alternative 6 (Overhead and Underground Options)



Source: California Energy Commission, 2014

CHAPTER 3:
Background on Submarine HVDC Technology

Review of HVDC Systems and Successful Submarine Installations

This chapter provides an overview of high-voltage submarine technology, describes major systems that are installed, and describes the Trans Bay Cable Project as an example of the HVDC technology in use in California today.

High-Voltage Submarine Transmission

Typical applications for offshore high-voltage electric transmission systems include interconnecting isolated grids, importing power from offshore generation (for example, wind power), and providing power to offshore facilities (for example, oil and gas production).

High-voltage alternating current power systems are the prevalent technology used to deliver electricity from power sources to consumers throughout the world. These are used because voltage levels on AC systems can be easily transformed from one voltage level to another and multiple AC transmission lines can be readily connected to each other using relatively simple equipment, switching, and protective devices. However, AC power systems incur power losses in several ways, including resistive losses and reactive losses. For underground or submarine cables in AC systems, additional losses occur in the form of cable charging and sheath losses. For AC systems to be configured in a manner that allows them to operate in a stable fashion, the system must be able to return to a synchronized equilibrium following a transient disturbance. Long AC underground or submarine transmission lines have attributes that can negatively impact electric system stability. Both of these factors, system stability and additional losses, explain why DC systems are most often used for underground and submarine transmission lines of notable length.

In contrast to typical AC power systems, HVDC systems are better suited for interconnecting isolated or unsynchronized networks over long distances. An HVDC system avoids or minimizes certain problems associated with AC systems (such as the charging current necessary due to cable capacitance in long conductors, and the higher thermal losses on AC systems). Although control and communications within an HVDC system can be more complex, HVDC systems can be operated to insulate connected AC systems from system stability issues and allows for more precise control of the power flow in either direction.

Transmission over an HVDC line reduces the required number of conductors when compared to AC transmission. Where AC transmission systems operate in a three-phase configuration, requiring three conductors (one per phase), DC systems may use a monopole or bipole configuration. (See discussion below on HVDC Transmission Configurations.) Monopole DC lines are vulnerable to loss of capability with the loss of any component. Common long-distance DC lines are in a bipole configuration with two conductors, one for each “pole” of the circuit (the positive pole and negative pole). Because fewer conductors are used for an HVDC system, a narrower footprint is needed and conductor costs are reduced. Equipment for converting AC

to DC and back to AC is costly, however, on long transmission lines this cost is offset by the lower conductor cost.

General Comparison of AC and DC Power Systems

General advantages and disadvantages of using HVDC technology instead of an AC transmission line between two transmission systems (National Renewable Energy Laboratory, 2011) would include:

HVDC Advantages

- Long-distance transmission with lower costs and losses.
- Ability to connect unsynchronized and weaker grids.
- No high capacitance effect on DC (no reactive losses).
- More power per conductor, with two conductors only.

HVDC Disadvantages

- High cost of converter stations.
- Complexity of control, communications, and so forth.
- Maintenance costs higher than for AC, unique spare parts needed.
- HVDC circuit breaker reliability issues.

Relative Costs

HVDC lines require construction of converter stations at each end of the line to connect with the AC transmission system. The high costs of the HVDC converter stations is a major factor limiting the use of HVDC technology to long-distance applications. An AC system would generally be less expensive than a DC system at distances of fewer than 250 miles overhead or less than 30 miles submarine (National Renewable Energy Laboratory, 2011). The HVDC converter stations require sufficient space (from 5 to 8 acres), seismic protection, and transportation infrastructure allowing construction access by large equipment.

Literature reviewed for this study indicates that each converter station would cost between $100 million to $200 million each, depending on capacity and configuration, and installing the submarine cable itself between the SCE and SDG&E territories could cost an additional $300 million to $600 million, for a project cost ranging up to roughly $1 billion.

Basic Submarine HVDC System Components

The two primary components of an HVDC transmission system are the AC/DC converter stations at each end of the HVDC line and the transmission line itself. Each of these components has subsystem technology choices for how to configure an HVDC system.

HVDC Converter Stations

Converting between a grid-based AC system power and a DC system occurs at converter stations. HVDC is a proven technology with systems in operation for more than 60 years. (A section below presents details on major HVDC installations that exist around the world.) The two technologies for conversion between AC and DC are either the original *current source converters* (CSC), also referred to as *line-commutated converters* (LCC), or the more recently developed *voltage source converters* (VSC).

LCC/CSC systems have some limitations related to the inability to commutate during electrically close fault conditions without nearby dynamic voltage support. The direction of current flow cannot be readily changed on LCC/CSC systems; therefore, these HVDC systems are best suited for interconnections where only unidirectional power flow is desired. In addition, since LCC/CSC systems rely on the connected AC system to provide the commutating voltage, it is not possible to feed power into the AC system unless synchronous machines (generators) are operating on the AC system. For this reason, an LCC/CSC HVDC system cannot provide black-start power into the AC system it interconnects.

VSC systems are highly controllable and address several issues associated with transmission systems. Since VSC systems do not require the dynamic voltage support from the AC system, these converters can be used to interconnect weak AC systems. VSC systems are also more compact than LCC/CSC systems. CSC systems are much easier to connect into a multiterminal HVDC system. Because the current flow direction can be reversed on these systems, they can provide for bidirectional power flow and are suited to interconnecting AC systems where power exchange in either direction is desired. VSC systems are self-commutated, giving them the capability to feed power into a passive AC system with loads but no operating synchronous machines (generators), thereby providing potential black-start power into the AC system.

HVDC converter stations include a variety of equipment in addition to the conversion equipment. DC converter stations also include AC and DC filters, cooling systems, switches, HVDC transformers, breakers, instrumentation, and communication equipment. The conversion equipment needs to be housed in a clean, controlled environment and, therefore, is enclosed in a building. The HVDC transformers differ from AC transformers in that they handle both AC and DC voltage stresses and are subject to high levels of harmonics.

Installing new HVDC converter stations at each terminating point would involve developing each site of about 5 to 8 acres to accommodate the VSC equipment, depending on the voltages of the systems and the power transfer capacity. Normally, the station would be housed within a structure with height between 40 and 80 feet; the footprint of the building would be from 400 to 600 feet on each side. Each converter station would also include an electrical yard and a fence enclosing the site.