SOLAR 2 BIOLOGICAL ASSESSMENT

Prepared for:

U.S. FISH AND WILDLIFE SERVICE
Carlsbad Fish and Wildlife Office

and

BUREAU OF LAND MANAGEMENT
El Centro Field Office
1661 S. 4th Street
El Centro CA 92243

December 23, 2009

URS

1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4314

TABLE OF CONTENTS

List of Acronyms and Abbreviations ..... **iv**
Section 1 Summary **1-1**
Section 2 Project Description **2-1**
2.1 Consultation History 2-1
2.2 Project Location 2-1
2.3 Action Area 2-1
2.4 Summary of Proposed Action 2-2
2.4.1 Technology 2-2
2.4.2 Project Summary 2-4
2.5 Project Description 2-5
2.5.1 Project Site Arrangement 2-6
2.5.2 Major Equipment 2-7
2.5.3 Electrical System Description 2-7
2.5.4 Pertinent Project Auxiliaries 2-7
2.5.5 Wastewater and Waste Management 2-15
2.5.6 Project Construction 2-16
2.5.7 Project Reliability 2-19
2.5.8 Project Closure 2-19
Section 3 Environmental Baseline **3-1**
3.1 Existing Site Conditions 3-1
3.2 Biological Setting 3-1
3.3 Vegetation Communities Present 3-2
3.4 Special Management Areas 3-2
Section 4 Flat-Tailed Horned Lizard **4-1**
4.1 Species Description and Range-Wide Status 4-1
4.1.1 Listing Status 4-1
4.1.2 Species Description 4-1
4.1.3 Distribution 4-2
4.1.4 Habitat Affinities 4-2
4.1.5 Life History 4-2
4.1.6 Population Trends 4-3
4.1.7 Threats 4-3
4.1.8 Critical Habitat 4-4
4.1.9 Synopsis of Status 4-5
4.2 Occurrence and Status of Flat-Tailed Horned Lizard on Site 4-5
4.2.1 Population Density within FTHL MAs 4-6

4.3 Effects of the Project on Flat-Tailed Horned Lizard 4-8
4.3.1 Direct Effects 4-8
4.3.2 Indirect Effects 4-9
4.4 Mitigation and Minimization Measures for Flat-Tailed Horned Lizard 4-12
4.4.1 Compliance with the Flat-Tailed Horned Lizard Rangewide Management Strategy 4-13
4.4.2 FTHL Relocation and Monitoring Plan 4-17
Section 5 Cumulative Effects 5-1
5.1 Flat-Tailed Horned Lizard 5-1
Section 6 Conclusion 6-1
6.1 Determination of Effect on Flat-Tailed Horned Lizard 6-1
Section 7 References 7-1
7.1 Personal Communications 7-2
Section 8 Tables 8-1
Section 9 Figures 9-1

List of Tables

Table 1: Major Equipment List 8-1
Table 2: Significant Structures and Equipment 8-3
Table 3: Water Usage Rates for Solar Two Project Operations 8-4
Table 4: Estimated Disturbed Area Summary 8-5
Table 5: Vegetation Types Occurring within the Solar Two Project Boundary and Off-Site Transmission Line and Waterline 8-7
Table 6: Overview of Acreage and Ownership of FTHL Management Areas (in acres) 8-7

List of Figures

Figure 1: Project Location and Surrounding Land Use 9-2
Figure 2: Project Overview Map 9-3
Figure 3: Final Site Plan with Roads 9-4
Figure 4: Color Photographic Simulation Close-up of the Site after Construction 9-5
Figure 5A: Solar Two 1.5-MW Solar Group Plan 9-6
Figure 5B: Solar Two 9-MW Solar Group Plan 9-7
Figure 5C: Solar Two 18-MW Solar Group Plan 9-8
Figure 5D: Solar Two Typical Elevation View 9-9

Figure 6: 1.5-MW Solar Two Construction Disturbance Plan.....9-10
Figure 7: Existing Site Conditions and Vegetation.....9-11
Figure 8: Flat-Tailed Horned Lizard Survey Plots 9-12
Figure 9: Flat-Tailed Horned Lizard Locations and Special Management Areas.....9-13

Appendices

Appendix A Flat-tailed Horned Lizard Population Estimates for the West Mesa, East Mesa, Yuma, and Yuha Basin Management Areas, 2007-2009. (Kristan 2009).

List of Acronyms and Abbreviations

ACEC	Area of Critical Environmental Concern
AFC	Application for Certification
Applicant or Solar Two	SES Solar Two, LLC
BLM	Bureau of Land Management
BMP	Best Management Practices
CAISO	California Independent System Operator
CBC	California Building Code
CBD	Center for Biological Diversity
CDFG	California Department of Fish and Game
dBA	A-weighted-decibel
DCH	Designated Critical Habitat
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
ft	foot
FTHL	Flat-tailed horned lizard
GSU	generator step-up unit
I-8	Interstate 8
IID	Imperial Irrigation District
Km2	Square Kilometers
Kv	Kilovolt
Leq	Equivalent sound level
LORS	Laws, Ordinances, Regulations, and Standards
MA	Management area
Mg/L	Milligrams per liter
mm	millimeters
MW	Megawatts
MWh/year	Megawatt hours per year
NAP	Not-a-Part
NTR	NTR plc
OHV	Off-Highway Vehicle
PBS&J	Post, Buckley, Schuh, & Jernigan, Inc.
PCU	Power Conversion Unit
PIT	Passive Integrate Transponder
PPA	Power Purchase Agreement
Project	Solar Two Project and its ancillary facilities
RO	Reverse Osmosis

ROW	Right-of-Way
RPS	Renewable Portfolio Standard
SCADA	Supervisory Control and Data Acquisition
SCWD	South Coast Water District
SDGE	San Diego Gas & Electric
SES	Stirling Energy System
SR	State Route
TDS	Total Dissolved Solids
URS	URS Corporation
USFWS	U.S. Fish and Wildlife Service
VAC	Volts Alternating Current
W/m2	Watts per square meter
WEAP	worker environmental awareness program
WWTF	Waste Water Treatment Facility

Section 1 Summary

SES Solar Two, LLC (Solar Two or Applicant) is seeking approval to construct and operate the Solar Two Project and its ancillary facilities (Project). The main objective of the Project is to provide clean, renewable, solar-powered electricity to the state of California. The electricity from the Project would assist the state in meeting its objectives as mandated by the California Renewable Portfolio Standard (RPS) Program and the California Global Warming Solutions Act. The Project would also address other local mandates adopted by California's electric utilities for the provision of renewable energy.

San Diego Gas & Electric (SDG&E) selected the Project to meet its objectives under the legislative requirements of the RPS Program through a least-cost, best-fit competitive solicitation. The Applicant and SDG&E entered into a 20-year Power Purchase Agreement (PPA) for the provision of renewable electricity. This PPA would help SDG&E meet both its statutory mandate to purchase at least 20 percent of its electric power from renewable resources by 2010 and its future electricity requirements. The California Public Utilities Commission approved the PPA on 1 December 2005. The Project represents approximately 44 percent of SDG&E's RPS goals. The Project would be an important deployment of large-scale renewable solar technology in a commercial setting. The Project would generate power using low-cost solar power generation equipment produced by an optimized, high-volume manufacturing design and infrastructure. Much of the power from the Project would be generated at peak times, when the demand for electricity is greatest.

The Applicant intends to develop an electric generating facility with a nominal capacity of 750 megawatts (MW) using concentrating solar power. The Project would be constructed on an approximate 6,500-acre site located in the Imperial Valley of California. The Project Site is approximately 100 miles east of San Diego, 14 miles west of El Centro, and approximately 4 miles east of Ocotillo Wells.

The Applicant is a wholly owned subsidiary of Stirling Energy Systems, Inc. The company recently received long-term funding from a strategic partner, NTR plc (NTR). NTR is an international developer and operator of renewable energy and sustainable waste management businesses in the United States, the United Kingdom, Ireland, and Continental Europe. The unique combination of the Applicant's technical expertise and NTR's track record in developing large-scale renewable energy and infrastructure projects provides a strong platform from which to realize the Project. This partnership is allowing Stirling Energy Systems to develop additional solar projects in other states and internationally.

One species proposed for federal listing as threatened has been detected on the project site, the flat-tailed horned lizard (*Phrynosoma mcallii*, FTHL).

The Solar Two Project was sited to avoid and minimize environmental impacts. In particular, the site was chosen to avoid the Area of Critical Environmental Concern (ACEC) located south of the Project site and Interstate 8. The Solar Two project may affect, and is likely to adversely affect FTHL. Take would occur by harassment, mortality, and loss of occupied FTHL habitat. Although only three individual FTHLs were encountered during field surveys in 2007-2008, it is estimated, through the process described below, that approximately 2,100 FTHLs may inhabit the Solar Two Project site. Moderate quality habitat for this species occurs throughout the site. All FTHLs encountered during pre-construction clearance surveys would be relocated and monitored in a designated area offsite. Habitat loss would be compensated at a 1:1 ratio for the Project site and 5:1 ratio for areas affected along the transmission line lies within the FTHL ACEC. These land replacement ratios would be achieved by provision of in-lieu fees provided to BLM, which would then purchase suitable habitat offsite. Acquired lands would be located within FTHL Management Areas, unless these private lands are unavailable for purchase.

Species	Listing Status	Determination
Flat-tailed Horned Lizard (*Phrynosoma mcallii*)	Proposed Listed as Threatened	May affect, and is likely to adversely affect; take by harassment, mortality, and loss of occupied habitat. Critical habitat has not been designated.

Two related federal actions are necessary for ultimate approval of this Project. The first is an individual permit from the Corps of Engineers in compliance with Section 404 of the Clean Water Act. The second is a loan guarantee from the Department of Energy for construction of alternative energy projects. The Bureau of Land Management is performing this conference with the Fish and Wildlife Service and has prepared this Biological Assessment on behalf of those two federal agencies.

This Biological Assessment was prepared by biologists from URS Corporation and edited by Dr. Larry LaPré of the California Desert District, Bureau of Land Management.

Section 2 Project Description

2.1 Consultation History

TBS by FWS

2.2 Project Location

The Solar Two Project Site is located in Imperial County, California, primarily on federal land administered by the Bureau of Land Management (BLM). The approximate 6,500-acre Project Site is approximately 100 miles east of San Diego, 14 miles west of El Centro, and 4 miles east of Ocotillo (Figure 1). The Project site is bordered by Interstate 8 to the south, County Highway S80 (aka Evan Hewes Highway) and a railroad to the west, north and northeast, and agricultural lands to the east. Plaster City, a gypsum plant run by United States Gypsum, is also on the northern boundary of the site.

The Project is in an area zoned for open space uses, as specified in the Imperial County General Land Use Plan; however, the Imperial County Land Use Ordinance lists electric generation as an allowed use within the agricultural zone. The area adjoining the Project is primarily undeveloped recreational desert land administered by the BLM. Land uses within 1 mile of the Project are almost exclusively open space with rural residential to the east and west and recreational and industrial land uses to the north. The Yuha Basin Area of Critical Environmental Concern is south of Interstate 8, and BLM-administered off-highway vehicle (OHV) recreation exists to the north in the Plaster City Open Area (Figure 1).

2.3 Action Area

The action area is defined as all areas affected directly or indirectly by the project, and not merely the immediate area involved. This includes off-site use areas such as pipelines, and staging areas. The action area for the Project includes the features provided in Figure 2. In addition to Phase I and Phase II of the project site, there are a proposed 11.8-mile water line, a proposed 10.3-mile transmission line, a 110-acre construction laydown area, and associated access roads. These Project features are discussed in more detail below.

2.4 Summary of Proposed Action

The Project would be one of the world's largest solar power projects. It would be owned and operated by SES Solar Two, LLC. The Project would consist of approximately 30,000 solar dish Stirling systems (referred to as SunCatchers), their associated equipment and systems, and their support infrastructure. The nominal design electric capacity of the Project is approximately 750 MW. The Project Site is approximately 6,500 acres and is located in Imperial County, California (see Figure 2).

An off-site 6-inch-diameter water supply pipeline would be constructed a distance of approximately 11.8 miles from the Seeley Waste Water Treatment Facility to the Project boundary as shown on the Figure 2. The water supply pipeline would be routed primarily within the Evan Hewes Highway Right-of-Way (ROW).

An off-site double-circuit generation interconnection transmission line would be constructed a distance of approximately 10.3 miles to connect the Solar Two Project to the SDG&E Imperial Valley Substation as shown on Figure 2.

A site access road would be constructed from Evan Hewes Highway south through the Project site. An emergency access road is proposed from Dunaway Road to the eastern boundary of the Project Site, as shown on Figure 2. The site access roads would generally follow existing BLM roads.

2.4.1 Technology

For the Project, the Applicant would deploy Stirling Energy Systems' (SES's) SunCatcher proprietary technology, which consists of solar concentrating dishes coupled with Solar Stirling Engine Power Conversion Units (PCUs). The SunCatcher technology has been developed, optimized, and matured during the past 20 years. It offers a number of distinct and unique benefits in the production of utility-scale electric power. These advantages include the items discussed below.

The Solar Two technology is the most efficient solar-powered electricity-generating technology currently deployed in the world. The SunCatcher technology is the world's most efficient solar power to grid-quality electricity system. The SES technology has held the world record since 1984 and in January 2008, SunCatcher broke its own record, achieving a conversion efficiency rating of 31.25 percent. The Solar Stirling Engine integrated into the SunCatcher delivers high part-load efficiency. Thus, little degradation of conversion efficiency occurs in suboptimal solar conditions, resulting in high annual performance.

The SunCatcher electric power generation profile aligns well with utility peak demand requirements and has a predictable “time-of-day” output. Solar insolation, the amount of incoming solar radiation, varies annually from summer to winter, which causes a similar variation in the daily output power of the Project.

Each SunCatcher consists of a PCU and a mirrored-surface dish assembly operating as a solar concentrator that automatically tracks the sun. The dish assembly collects and focuses solar energy onto the PCU to generate electricity. Each PCU consists of a solar receiver heat exchanger and a closed-cycle, high-efficiency Solar Stirling Engine specifically designed to convert solar power to rotary power via a thermal conversion process. The engine drives an electrical generator to produce grid-quality electricity. Power generated by the 1.5-MW groups of 60 SunCatchers per group would be collected through a 600-volt underground power collection system. This collection system would combine the output from the units and connect each 1.5-MW group to a generator step-up unit (GSU) transformer with an output voltage of 34.5 kilovolt (kV). The output from the GSUs would be grouped into 3-, 6-, and 9-MW groups, which would be connected via 34.5-kV underground collection circuits to 48- or 51-MW, 34.5-kV overhead collection circuits, each of which would be connected directly to the on-site collection substation. The on-site collection substation would be connected via a 230-kV, double-circuit overhead interconnection transmission line for delivery of generated electricity to the SDG&E Imperial Valley Substation, where the interconnect to the California Independent System Operator (CAISO)-controlled grid would take place.

The system has high durability, with a long life. This technology has been in operation since 1984 with no appreciable loss in any of the key performance criteria (reflectivity, electrical output, structural integrity, or efficiency). In fact, prototypes have been built and moved to various locations in the 24-year lifetime of the technology with no appreciable degradation in performance.

The technology has as modular design. Each SunCatcher is a highly efficient, self-contained electricity generator. This leads to the advantages listed below.

- **Immediate Power Production:** This technology allows immediate power production from units or groups of units as they are installed. A key result of this is that the overall cost of the Project is reduced due to the combined impacts of higher efficiencies and earlier generation of electricity during the installation period.

- **High Availability:** The modularity of the Project facilities provides a high degree of redundancy which benefits overall availability. The failure of any specific unit or group of units would not have an adverse effect on the performance of the overall Project. The total annual capacity factor is approximately 25 percent. Based on

historical performance discussed above the capacity factor is not expected to diminish appreciably over the lifetime of the units.

- **Terrain Tolerance:** The modularity allows the units to be installed on sloping land with up to a ten percent grade. This significantly reduces the requirements for grading of sites, thereby minimizing ground disturbance.

- **Mass Production:** Modularity allows high volume and low cost automotive-style mass production. This type of mass production also provides the opportunity for high-precision, highly consistent quality of manufacturing, which translates into higher reliability of system performance. Another advantage of mass production processing is the ability to work in controlled factory environments that are designed and operated based on lean manufacturing principles. The result is considerably lower levels of waste generation throughout the process, both in manufacturing and site deployment. Furthermore, modularity facilitates recycling and management of the waste generated. An additional benefit is that manufacturing at off-site factories would result in reduced disturbance of the Project Site during installation.

In addition, the technology has environmentally sound advantages. The SunCatcher[1] technology does not employ steam in its generation process, and the only water consumption specific to the SunCatcher technology is that required for mirror washing. The SunCatchers also do not consume fossil fuels; therefore, no combustion emissions are specifically associated with the operation of this technology. Finally, the Project does not require the use of any Class I controlled hazardous materials.

2.4.2 Project Summary

The Project would be constructed in two phases. Construction of the Solar Two Project is expected to begin in early 2010 and will take approximately 44 months for full project completion. As shown on Figure 3, Phase I of the Project would consist of up to 12,000 SunCatchers configured in 200 1.5-MW solar groups of 60 SunCatchers per group that would have a net nominal generating capacity of 300 MW. As shown on Figure 3, Phase II would expand the Project to approximately 30,000 SunCatchers configured in 500 1.5-MW solar groups with a total net generating capacity of 750 MW. The Project would be connected to the SDG&E Imperial Valley Substation via an approximate 10.3-mile, double-circuit, 230-kV

[1] These references are for the SunCatcher systems. Limited water and fuel consumption and vehicle emissions associated with operation and maintenance activities for a utility-scale power plant would still be required.

transmission line. No other new transmission lines or off-site substations would be required for the 300-MW Phase I construction. The full Phase II expansion of the Project would require the construction of the 500-kV Sunrise Powerlink transmission line project (or equivalent) proposed by SDG&E. Within the Project boundary, Phase I requires approximately 2,600 acres and Phase II requires approximately 3,500 acres. The total area required for both phases, including the area for the operation and administration building, the maintenance building, and the substation building, is approximately 6,500 acres.

The 230-kV transmission line that would be built for Phase I would parallel the existing SDG&E Southwest Powerlink transmission line within the previously disturbed ROW. A water supply pipeline for the Project would be built to the northeast within the State Route 80 ROW. The Applicant has applied for a ROW grant for the Project Site from the BLM California Desert District. Although the Project is phased, it is being analyzed in this Biological Assessment as if all phases would be operational.

The Project would include the construction of a new 230-kV substation approximately in the center of the Project site (Figure 2). The Project design would minimize land disturbance, and the Project would operate with no fossil-fuel emissions from the electric generation process. Raw water would be stored on-site for operational needs. Most storm water would be passed through the site utilizing existing dry washes and without any significant diversions or retention. A very small amount of rainfall runoff would be collected and percolated into the ground. Activities would be conducted at the Main Services Complex, where key buildings and parking areas would be located. Main roads would be constructed with a combination of roadway dips and elevated sections across the dry washes. Minimal grading will be required for the project. The sanitary system would consist of a buried septic tank system with a dual sanitary leach field.

The main entry for truck traffic to the Project Site during construction would be from Interstate 8 (I-8) to the Project entrance on Dunaway Road. Traffic would exit the Project Site at the north end of the site onto the Evan Hewes Highway. During Project operation, the main access (entry and exit) to the site would be from Evan Hewes Highway on the north side of the Project Site. During Project operation, the secondary and emergency access would be from Dunaway Road.

2.5 Project Description

This section describes the Project site arrangement, the Project conceptual design, Project processes, and the operation of the Project. All Project facilities would be designed, constructed, and operated in accordance with applicable laws, ordinances, regulations, and standards (LORS). A computer-generated photo simulation of the Project is shown on Figure 4,

which provides a close-up simulation of the southeast corner of the Project Site looking west, after construction.

2.5.1 Project Site Arrangement

The site plan for the Project is shown on Figure 3. The basic building block for the Project is a 1.5-MW solar group consisting of 60 SunCatchers, as shown on Figure 5A, Solar Two 1.5-MW Solar Group Plan. The 1.5-MW groups would be connected in series to create 3-, 6-, and 9-MW solar groups. A typical 9-MW group is shown on Figure 5B, Solar Two 9-MW Solar Group Plan. The 3-, 6-, and 9-MW groups would be connected to overhead collection lines rated at 48 MW or 51 MW. A typical 18-MW solar group showing two 9-MW groups connected to the overhead collection lines is shown on Figure 5C. Typical elevation views of a 6-MW portion of the solar field are provided on Figure 5D. The typical solar groups would be arranged as necessary to fit the contours of the site. These figures illustrate the location, equipment arrangement, and size of the generation equipment for the Project.

The entire working Project would be fenced. The Project would have two laydown areas (Figure 2). One laydown area would be located on approximately 110 acres east of Dunaway Road and north of I-8. The other laydown area would be located on approximately 11 acres adjacent to and immediately south of the Main Services Complex.

The fenced boundary of the Project would encompass approximately 6,500 acres of land, not including the private parcels of land designated as Not-a-Part (NAP) of the Project. Access to the federal land managed by the BLM would be authorized under a ROW permit.

During Project construction, the main entry to the Project Site would be from the east, from Dunaway Road; the main exit from the Project Site would be to the north, onto the Evan Hewes Highway. During Project operation, main site access (entry and exit) would be from Evan Hewes Highway from the north of the site via Dunaway Road and I-8. Secondary access would be from the east via Dunaway Road and I-8. The following roadways would be constructed on the Project Site:

- approximately 2 miles of paved access roads, and
- approximately 240 miles of acrylic polymer treated access routes associated with the solar groups and perimeter and arterial roads.

The soiltac roads (polymeric stabilizer) would reduce fugitive dust while allowing full access to all dishes and infrastructure. All access to the Project Site would be through controlled gates.

2.5.2 Major Equipment

Table 1, Major Equipment List, and Table 2, Significant Structures and Equipment, list the major equipment and significant structures required for the Solar Two Project.

2.5.3 Electrical System Description

Electrical service for the Main Services Complex, the water treatment structure, the water pumping stations, and other auxiliary structures would be provided separately from the Project power generation system and would be provided from the Imperial Irrigation District (IID) electrical distribution lines located north of Evan Hewes Highway by means of overhead service lines to be constructed by IID.

The diesel-powered standby power generator would be sized to provide continuous power for control rooms and other critical process loads. The estimated size of the diesel generator for the Main Services Complex is 250 kW, 480 VAC, three-phase service.

2.5.4 Pertinent Project Auxiliaries

2.5.4.1 Lighting

Project building lighting would be a minimum 50-foot candle illumination from combined day lighting and high-intensity discharge, high-efficiency lighting in the assembly and maintenance facility. Day lighting would supplement energy-efficient fluorescent lighting in the operation and administration and water treatment buildings. Emergency egress identification and path lighting would be provided per building code requirements.

Site parking lighting would be designed to minimum traffic flow safety standards for personnel safety. Full cut-off lighting fixtures would be used to control night sky light pollution. Project building exterior and support area lighting design would incorporate minimum personnel safety and security lighting levels while utilizing full cut-off lighting fixtures to control light pollution. Aviation obstruction lighting would be provided as required by the Federal Aviation Administration (FAA). Reflective warning signage would be included on perimeter fencing.

2.5.4.2 Buildings

All buildings would be constructed in accordance with the appropriate edition of the California Building Code (CBC) and other applicable LORS. The location of the Main Services Complex is depicted on Figure 1.

The Main Services Complex would be located within the Project Site in a central location that provides for efficient access routes for maintenance vehicles servicing the SunCatcher solar field. The main control room, SCADA, and UPS would be located at the Main Services Complex.

Warehouse and shop spaces would provide work areas and storage for spare parts for Project maintenance. The Main Services Complex would contain meeting and training rooms, maintenance and engineering offices, and administrative offices. The Project administration offices and personnel facilities would be located in a one-story operation and administration building.

The Project maintenance facilities, shop, and warehouse storage would be located adjacent to the operation and administration building. This building would contain maintenance shops and offices, PCU rebuild areas, maintenance vehicle servicing bays, chemical storage rooms, the main electrical room, and warehouse storage for maintenance parts to service the SunCatchers.

A water treatment shade structure would be located next to the Main Services Complex. The water treatment structure would house water treatment equipment and safe storage areas for water treatment chemicals. A motor control center for the water treatment equipment and pumps would be located within this structure. Two wastewater evaporative ponds designed for water treatment wastewater containment would be located in the proximity of the water treatment structure.

A control building would be located near the Project substation. This building would contain relay and control systems for the substation in one room and the Project operations control room in another room or rooms.

An electric-powered fire water pump and a diesel operated standby power generator would be located adjacent to the operation and administration building on the north side.

Communications service for the Main Services Complex would be obtained from L3 Communications Holdings, Inc. or from another provider in the area. Communications service would be provided via an overhead service from existing underground communications lines located on the north side of the railroad located south of Evan Hewes Highway.

The operation and administration building, maintenance building, and Main Services Complex would be painted with a matching desert sand color and would be manufactured buildings. The water treatment building and the water holding tanks, including the potable water, raw water, and demineralized/fire protection water tanks located at the Main Services Complex would also be painted with a matching desert sand color.

SunCatcher assembly would be performed on-site in temporary structures. These buildings would be decommissioned after all Project SunCatchers are assembled and installed. The three assembly buildings would be located beside the Main Services Complex. Each assembly building would be located on a pad for the storage of SunCatcher components and assembled SunCatcher staging before field installation.

The primary purpose of the SunCatcher assembly buildings would be the assembly of the SunCatcher superstructure, the main beam assembly and trusses, the pedestal trunnion, mirrors, wire harnesses, control systems, drive position motors, and the calibration of the mirrors and control systems before field installation. Each assembly bay would be equipped with an automated platform on locating rails to move the SunCatcher through the assembly process.

The exterior material for the assembly buildings would be a fire retardant vinyl fluoride film with ultraviolet blocking characteristics and would be chemical and weather resistant.

Transport trailer storage would be located south of the assembly bays. This storage facility would accommodate approximately 75 to 100 trailers, maintaining 3 to 5 days of inventory of SunCatcher parts during the assembly phase of construction.

These assembly buildings would be decommissioned and salvaged after all SunCatchers for the Project are installed.

2.5.4.3 Roads

- Site access during the construction phase would be provided from Dunaway Road, which has an existing interchange from I-8 at the southeastern corner of the Solar Two Project Site. The site arrangement is illustrated in Figure 3, which illustrates a network of two types of roads proposed for servicing the Project:

- approximately 2 miles of paved access roadways (only offsite access roads would be paved), and

- approximately 240 miles of acrylic polymer treated access routes associated with solar groups and perimeter and arterial roads.

Polymeric stabilizers would be used in lieu of traditional road construction materials (e.g., asphalt) for paved roads or to stabilize unpaved roads. The arterial roadways may be designed with one 12-foot lane in each direction or as one-way roads with one 10-foot lane. These paved arterial roads would allow for a looped access to the Main Services Complex, unpaved solar field access routes, access to private properties within the site, and access to the electrical substation. Paving would be placed exclusively on the access road from Evan Hewes Highway to provide for improved solar field access and to minimize fugitive dust generation. The looped roads would provide for redundancy in the event that a road is blocked because of local SunCatcher maintenance, construction traffic, or other local disruption.

Where paved arterial roadways are not located adjacent to the perimeter fence, 10-foot unpaved one-way roads would be provided to allow for patrolling of the site by the security personnel and for maintenance of the perimeter fence. Unpaved perimeter roads would be constructed with polymeric stabilizers over compacted natural ground. Fugitive dust control would be added to the perimeter roadways as needed to minimize dust generation.

The unpaved solar field access routes would be designed for minimum roadway blading (at grade routes) to allow for individual SunCatcher access for installation and maintenance. The unpaved solar field access routes would allow for localized access for maintenance service vehicles, and would be constructed per the recommendations of the Soils Engineer based on the expected construction and maintenance traffic loads. To minimize site disturbance, the construction for unpaved north-south access routes would be located along the center of a 112-foot area along every other row of SunCatchers. Between rows, a 72-foot area would be left intact and generally undisturbed except for brush trimming as may be required to reduce fire hazard and shading of SunCatchers. Unpaved east-west access routes would be limited to the alignments, or projection thereof, where electrical cables have been installed in an east-west direction. Temporary site stabilization measures such as metal plates or soil reinforcement mats, and/or polymeric stabilizers may be used to access SunCatchers, if required.

The Main Services Complex parking lot, trailer storage areas, and the roads circling SunCatcher assembly bays would also be paved using asphalt or polymeric stabilizers. Concrete paving may be utilized in loading and storage areas.

2.5.4.4 Site Security

Perimeter security fencing and access gates would be provided for the Project Site, including additional fencing and gates around the main buildings, the electrical substation, and construction laydown areas. The security fencing would be provided with warning reflective signage. All site security monitoring would be able to be displayed on a real-time as well as a

recorded basis. Security monitoring cameras and active detection systems would be provided for all Project buildings, support areas, and the entire site perimeter. Regular site security vehicular patrols would be conducted to provide additional site security. Site access would be provided to off-site emergency response teams that respond in the event of an “after-hours emergency.” Entry into the Project Site by fire department or emergency units would be handled on a manual override basis by 24-hour security officers stationed at both entrances.

2.5.4.5 Site Grading and Drainage

Brush trimming would be conducted within solar groups, and consists of cutting the top of the existing brush while leaving the existing native plant root system in place to minimize soil erosion. After brush has been trimmed, blading for roadways and SunCatcher pedestals would be conducted between alternating rows to provide access to individual SunCatchers. Blading would consist of limited removal of terrain undulations. Ground disturbance would be minimized wherever possible. Localized rises or depressions within the individual 1.5-MW solar groups would be removed to provide for proper alignment and operation of the individual SunCatchers. To minimize shading on SunCatchers and prevent potential brush fire hazards, natural vegetation would be trimmed in the area of each SunCatcher as well as on either side of the paved arterial roadways.

Paved roadways would be constructed as close to the existing topography as possible, with limited cut-and-fill operations to maintain roadway design slope to within a maximum of 10 percent.

The Site layout would maintain the local pre-development drainage patterns where feasible, and water discharge from the Site would remain at the eastern boundary. The paved roadways would have a low-flow, unpaved swale or roadway dip as needed to convey local runoff to existing drainage channels/swales and would use low-flow culverts. It is expected that storm water runoff would flow over the crown of the paved roadways, which are typically less than 6 inches from swale flow line to crown at centerline of roadway, thus maintaining existing local drainage patterns during storms. Unpaved roads would utilize low-flow culverts.

Localized channel grading would take place on a limited basis to improve channel hydraulics within the dry washes and to control flow direction where buildings and roadways are proposed. The Main Services Complex would be protected from a 100-year flood by berms or channels that would direct the flow around the perimeter of the building site, if required.

Arizona crossings would be placed along the roadways or low-flow culverts as needed to cross the minor or major channels/swales. These designs would be based on Best Management

Practices (BMPs) for erosion and sediment control. Arizona crossings would be used for major washes where the channel cross section exceeds 8 feet in width and 3 feet in depth or exceeds 20 feet in width and 2 feet in depth. The roadway section at the channel flow line would be without a crown. Because polymeric stabilizers are used, no protection measures would be used or protection may be limited to un-grouted (loose) riprap at critical areas.

The proposed east-west on-site paved arterial roadway section between the Main Services Complex and Dunaway Road would be designed as a designated evacuation route. As such, the culverts for this roadway would be designed such that the roadway section shall have its driving surface constructed 6 inches below the projected profile of a 100-year event.

It is anticipated that roadway maintenance would be required after rainfall events. For minor storm events, it is anticipated that the unpaved roadway sections may need to be bladed to remove soil deposition, along with sediment removal from sediment basins at the culvert locations. For major storm events, in addition to the aforementioned maintenance, roadway repairs may be required due to possible damage to pavement where the roadways cross the channels and where the flows exceed the culvert capacity.

Building sites would be developed per county drainage criteria, with provision for soft bottom storm water retention basins. Rainfall from paved areas and building roofs would be collected and directed to the storm water retention basins. Volume on retention or detention basins should have a total volume capacity for a 3-inch minimum precipitation covering the improved areas with no C reduction (coefficient of runoff) factors. Volume can be considered by a combination of basin size and additional volume provided within paving and/or landscaping areas.

The retention basin would be designed so that the retained flows would empty within 72 hours after the storm to provide mosquito abatement. This design can be accomplished by draining, evaporation, infiltration, or a combination thereof.

The post-development flow rates released from the Project Site are expected to be less than the pre-development flow rates, thus complying with BMPs. The expected flow reduction is based on the following factors.

- Except for the building sites, the majority of the Project Site would remain 100 percent pervious, as only a negligible portion of the site would be affected by pavement and SunCatchers foundations.

- The increased runoff expected from the building sites would be over-mitigated by capturing the portion of the runoff above pre-developed levels in a retention basin, where the storm runoff would be infiltrated and/or evaporated to the atmosphere.
- The proposed perforated risers to be constructed upstream of the roadway culverts would provide for additional detention.

2.5.4.6 Raw Water Supply Line

SES would construct approximately 11.8 miles of pipeline from the Seeley Wastewater Treatment Facility (WWTF) to the Main Services Complex, primarily along the Evan Hewes Highway ROW. This pipeline would be buried within the ROW of Evan Hewes Highway approximately 30 inches below the existing grade. The line would enter the Project approximately 1,000 yards east of Plaster City and then run due south to the Main Services Complex.

The project would obtain water from this source for mirror washing. The applicant estimates that 33 acre-feet of water would be used annually for mirror washing and domestic use. Potable water to meet plant requirements would be delivered by truck and stored in a 5000-gallon tank in the water treatment area. This tank would be able to provide all required potable water for the operating facility for 2-3 days, at which time it would need to be replenished.

2.5.4.7 Water Supply Source

After evaluating the currently available water supply options, SES has concluded that the primary source of water for the Project would be furnished by the WWTF. SES would have access to at least 150,000 gallons and up to 200,000 gallons of reclaimed water per day, which would meet the Title 22 requirements, for use in all construction and operation activities except for potable water.

Seeley WWTF has agreed to provide reclaimed water to SES Solar Two. An agreement between Seeley WWTF and SES Solar Two, LLC was signed at the Seeley Board Meeting on May 18, 2009. Water usage rates for the Project operations are provided in Table 3.

2.5.4.8 Water Treatment Requirements

SunCatcher mirror washing requires the water to be demineralized to prevent mineral deposits forming on the SunCatcher mirrors. Processes available for demineralization are reverse

osmosis (RO) and ion exchange. RO with a de-silting pretreatment application is the preferred process. Ion exchange requires the use of hazardous chemicals, including sulfuric acid and caustic soda. Downtime for scheduled maintenance and media regeneration are significantly longer using the ion exchange process than for an RO system. RO provides additional operational and cost benefits as well.

The treatment requirements and the process units necessary to achieve a level of water quality suitable for potable and fire water needs would be further evaluated during final Project engineering. This engineering would include an evaluation of the treatment equipment and processes available to provide the required process water at the flow and quality needed for mirror washing. This equipment evaluation would include demineralizer systems and a look at alternate treatment methods.

Water for domestic use would meet Environmental Protection Agency (EPA) standards. Disinfection would be required as an additional treatment process to produce water that meets drinking water standards. This water would be stored in a separate potable water storage tank.

SunCatcher Mirror Washing

Water from the Seeley WWTF is expected to have approximately 810 milligrams per liter (mg/L) of total dissolved solids (TDS). The water treatment process would be a RO membrane-based system that would produce demineralized water with a TDS of less than 20 mg/L. The daily average water requirement for SunCatcher mirror washing under regular maintenance routines would be approximately 10.4 gallons per minute.

Fire Protection Water

The Main Services Complex would include a location for an approximately 175,000-gallon tank that would be used to store water for SunCatcher mirror washing and fire protection. This volume of water would meet all LORS, including the El Centro Fire Department Prevention Division requirements for fire water.

Dust Control Water

Primary fugitive dust suppression during construction would use raw water from the WWTF. The raw water would be conveyed to the Main Services Complex via a 8-inch-diameter water line.

Initially, raw water would be used in the areas disturbed by construction during the construction activity for the primary access routes, the construction laydown areas, the grading of the sites

for the Main Services Complex and the Satellite Services Complex, and the substation sites, as well as areas disturbed by the construction of each 18-MW or 24-MW solar group.

Water trucks would be used throughout the duration of the construction phase for the Solar Two Project. Based on the construction schedule, the annual average water flow rate during construction is approximately 26,000 gallons per day for construction water and 11,500 gallons per day for dust control. The peak water flow rate is approximately 353,000 gallons per day for construction water and for dust control.

Potable Water

In 1971, laws and regulations governing the certification of potable water treatment facility operation were enacted. These laws and regulations establish the level at which water treatment facilities should be manned; the minimum qualifications for testing at each of the five grade levels, and the criteria for renewal and revocation of certificates. The potable water would be brought on site and stored in a designated storage facility equipped with chemical dosage for disinfection. The potable water would meet all EPA potable water quality standards.

2.5.5 Wastewater and Waste Management

The water treatment wastewater generated by the RO unit contains relatively high concentrations of TDS. Wastewater or brine generated by the RO unit would be discharged to two double-lined evaporation ponds, or equivalent. Each pond would be sized to contain 1 year of discharge flow, approximately 2.44 million gallons. A minimum of 1 year is required for the water treatment waste to undergo the evaporation process. The second pond would be in operation while the first is undergoing evaporation. The two ponds would alternate their functions on an annual basis. The solids would be scheduled for removal during the summer months, when the concentration of solids is at its greatest due to an increase in evaporation rates, in order to achieve maximum solids removal.

The brine constituents include those from the raw water source as shown in the Table 5, Raw Water Quality Analysis, with concentrations of up to four to five times those of the raw water source. The TDS concentration anticipated in the brine when treating to less than 20 mg/L of TDS is approximately 3,600 mg/L based on the source TDS level of 810 mg/L.

After the brine has gone through the evaporation process, the solids that settle at the bottom of the evaporation pond would be tested by the Applicant and disposed of in an appropriate non-hazardous waste disposal facility. Additionally, the Applicant will provide a year of data from

monitoring wells around the location of the evaporation ponds prior to use of the evaporation ponds. This data will be compared to data collected once the evaporation ponds are being used.

2.5.6 Project Construction

2.5.6.1 Project Construction Schedule

The Solar Two Project would be developed in two phases. The schedule would be approximately 58 months in duration, and construction would require approximately 40 months. As of the date of this document, construction is planned to begin September 2010. Major milestones are listed in Table 6, Project Schedule Major Milestones.

Heavy construction for the Project would be scheduled to occur between 0700 and 1900 Monday through Friday. Additional hours may be necessary to make up schedule deficiencies or to complete critical construction activities.

Some activities would continue 24 hours per day, 7 days per week. These activities include, but are not limited to, SunCatcher assembly, refueling of equipment, staging of materials for the next day's construction activities, quality assurance/control, and commissioning.

The Project Site would be fenced at the start of construction. The construction entrance to the site would be via a gated entrance from Dunaway Road at the eastern boundary of the site. A second gated entrance would be provided on the northern boundary of the site, to Evan Hewes Highway. The Dunaway Road gate would be used for constructed-related entry. The Evan Hewes Highway gate would be used for construction-related exit from the site; this gate would also be used for both entry and exist during Project operations once the first portion of the Project is energized and tied to the grid.

The construction laydown and staging area east of Dunaway Road would be fenced with a temporary chain-link fence, with a gated entrance and egress from Dunaway Road.

2.5.6.2 Site Mobilization

Project facilities and amenities would be established during the first quarter of the build-out. The majority of these facilities would be located in the 11-acre construction laydown area adjacent to the Main Services Complex, which would be located within the Project Site approximately 1.5 miles south of the construction exit gate at Evan Hewes Highway. Project amenities would consist of site offices, restroom facilities, meal rooms, limited parking areas, vehicle marshalling

areas/traffic staging, and construction material/equipment storage areas. Construction power to the Project Site facilities would be provided by mobile diesel-driven generator sets and/or temporary service(s) from IID. Additional construction employee parking would be provided on the 110-acre laydown and staging area east of Dunaway Road. Employees would be moved to and from the Project Site from surrounding areas and/or the Dunaway Road parking area in up to 10 buses and other mass conveyance vehicles.

2.5.6.3 Project Site Preparation

Site preparation would be based on avoiding major washes and minimizing surface-disturbing activities. Also, areas of sensitive habitat and cultural resources would be avoided wherever possible.

Brush trimming would be conducted between alternating rows of SunCatchers, as illustrated in Figure 5A, Solar Two 1.5-MW Solar Group Plan. Brush trimming consists of cutting the top of the existing brush while leaving the existing native plant root system in place to minimize soil erosion.

After brush has been trimmed, blading for roadways and SunCatcher pedestals would be conducted between alternating rows of SunCatchers, as illustrated in Figure 6, 1.5-MW Solar Two Project Construction Disturbance Plan, to provide access to individual SunCatchers, as needed. Blading would consist of removing terrain undulations and would be limited to 3 feet in cut and 3 feet in fill. The blading operations would keep native soils within 100 feet of the pre-development location, with no hauling of soils across the site. Localized rises or depressions within the individual 1.5-MW solar groups would be removed to provide for proper alignment and operation of the individual SunCatchers.

Paved roadways would be constructed as close to the existing topography as possible, with limited cut-and-fill operations to maintain roadway design slope to within a maximum of 10 percent.

Limited localized channel grading would take place to improve channel hydraulics and to control flow direction where buildings and roadways are proposed. The Main Services Complex and the electrical substation would be protected from a 100-year flood by berms or channels that would direct the flow around the perimeter of these sites, if required. Placement of fill within jurisdictional drainages would be permitted by the Corps of Engineers.

Minor grading would also be required for building foundations and pads and parking areas in the Main Services Complex and substation areas.

The clearing, blading, and grading operations would be undertaken using standard contractor heavy equipment. This equipment would consist of, but not be limited to, motorgraders, bulldozers, elevating scrapers, hydraulic excavators, tired loaders, compacting rollers, and dump trucks.

2.5.6.4 Foundations

From the preliminary geotechnical investigations, it is expected that lightly loaded equipment and structures, including some of the equipment foundations in the substation yard, small equipment such as the fire water pump and standby generator, the support structures for the water treatment plant and the hydrogen storage area, and the transmission line lattice steel towers would be supported on shallow footings. Shallow footings would be continuous strip and isolated spread footings.

The majority of SunCatchers would be supported by a single metal pipe (2 ft diameter) foundation that is vibrated into the ground. These foundations are expected to be approximately 20 feet long and 24 inches in diameter, with 12-inch wide fins extending from each side of the pipe pile. Shallow drilled pier concrete foundations of approximately 36 inches in diameter and an embedment depth with a minimum socketed depth into rock of 6 feet would be used for hard and rock-like ground conditions. The buildings and major structures such as yard tanks would be supported on shallow spread and continuous footings or mat-type foundations. Deep foundations would be required for heavy items, such as the power transformers at the electrical substation.

2.5.6.5 Land Disturbance

The estimated land disturbance for the Project is provided in Table 4, Estimated Disturbed Area Summary. Figure 6, 1.5-MW Solar Two Construction Disturbance Plan, shows the disturbed area for a typical 1.5-MW solar group.

2.5.6.6 Dish Assembly

The SunCatcher Dish Assembly is fitted with a trunnion that attaches to the pedestal. Each Dish Assembly consists of a 38-foot by 40-foot steel structure that supports an array of curved glass mirror facets. These mirrors form a curved shape engineered to concentrate solar energy onto the solar receiver portion of the PCU. The Dish Assembly includes azimuth and elevation drives for tracking the sun and a PCU support boom.

The SunCatcher Dish Positioning Control System employs proprietary algorithms to track the sun. This system focuses the solar energy onto the solar receiver by controlling elevation and azimuth drives, and executes startup, shutdown, and de-track procedures. These procedures allow the dish to “wake up” from the night-stow position in the morning to focus the dish mirror facets on the solar receiver of the PCU, and then to track the sun during the daylight operating time of the Project. The dish control system also communicates with and receives instructions from the central control room via the SCADA system. The system is designed to place the dish into a “wind stow” position when sustained winds exceed 35 miles per hour to protect the system from wind damage. The system also places the dish into “wind stow” position on loss of communications with the central control room or on receipt of a fault signal from the PCU control system.

2.5.7 Project Reliability

This section discusses the expected Project availability, equipment redundancy, the reliability of the water supply, and Project quality control measures.

The Solar Two Project has a designed operating life of 40 years and is capable approximately 3,500 hours of annual electricity production, with a projected annual availability of approximately 99 percent while on-sun. The annual net energy to be produced by the Project is estimated to be approximately 1,620,000 MWh/year at full build-out.

The SunCatcher generates “as available” electricity, depending on cloud cover and wind conditions. The Project is a peaking resource, generating more power in the highest solar insolation of the day (afternoons) when the solar energy input is the highest (over 1,000 W/m2). Of all solar technologies, the SunCatcher can operate with the least amount of solar input and can recover more quickly when clouds pass over the site. Winds greater than 35 miles per hour would require the SunCatcher to shut down into a safe stow position, and cloud cover and the times of sunrise and sunset affect the SunCatcher power generating capability.

Reliability and availability projections are based on a 40-year operating life. Operations and maintenance procedures would be consistent with industry standard practices to maintain the useful life of all Project equipment.

2.5.8 Project Closure

Project closure can be temporary or permanent. Temporary closure is defined as a shutdown for a period exceeding the time required for normal maintenance, including closure for overhaul or replacement of the major components, such as major transformers, switchgear, etc. Causes for

temporary closure include inclement weather and/or natural hazards (e.g., winds in excess of 35 mph, or cloudy conditions limiting solar insolation values to below the minimum solar insolation required for positive power generation), or damage to the Project from earthquake, fire, storm, or other natural acts. Permanent closure is defined as a cessation in operations with no intent to restart operations owing to Project age, damage to the Project that is beyond repair, adverse economic conditions, or other significant reasons.

2.5.8.1 Temporary Closure

In the unforeseen event that the Project is temporarily closed, a contingency plan for the temporary cessation of operations would be implemented. The contingency plan would be followed to ensure conformance with applicable LORS and to protect public health, safety, and the environment. The plan, depending on the expected duration of the shutdown, may include the draining of chemicals from storage tanks and other equipment and the safe shutdown of equipment. Wastes would be disposed of according to applicable LORS.

2.5.8.2 Permanent Closure

The planned life of the Solar Two Project is 40 years; however, if the Project is still economically viable, it could be operated longer. It is also possible that the Project could become economically noncompetitive before 40 years have passed, forcing early decommissioning. Whenever the Project is permanently closed, the closure procedure would follow a plan that would be developed as described below.

The removal of the Project from service, or decommissioning, may range from “mothballing” to the removal of equipment and appurtenant facilities, depending on conditions at the time. Because the conditions that would affect the decommissioning decision are largely unknown at this time, these conditions would be presented to the CEC, the BLM, and other applicable agencies.

To ensure that public health, safety, and the environment are protected during decommissioning, a decommissioning plan would be submitted to the CEC for approval before decommissioning. The plan would discuss the following:

- proposed decommissioning activities for the Project and appurtenant facilities constructed as part of the Project,
- conformance of the proposed decommissioning activities with applicable LORS and local/regional plans,

- activities necessary to restore the Project Site if the plan requires removal of equipment and appurtenant facilities,
- decommissioning alternatives other than complete restoration to the original condition, and
- associated costs of the proposed decommissioning and the source of funds to pay for the decommissioning.

In general, the decommissioning plan for the Project would attempt to maximize the recycling of Project components. Solar Two would attempt to sell unused chemicals back to the suppliers or other purchasers or users. Equipment containing chemicals would be drained and shut down to ensure public health and safety and to protect the environment. Nonhazardous wastes would be collected and disposed of in appropriate landfills or waste collection facilities. Hazardous wastes would be disposed of according to applicable LORS. The site would be secured 24 hours per day during the decommissioning activities, and Solar Two would provide periodic update reports to the CEC, the BLM, and other appropriate parties.

Section 3 Environmental Baseline

3.1 Existing Site Conditions

The Solar Two Project is located in Imperial County in Southern California. The Project would be located on approximately 6,150 acres of federal land to be authorized under a ROW permit from the BLM and approximately 320 acres of private land, which would be either purchased or leased by Solar Two.

The Project Site currently primarily consists of undisturbed desert on federal lands. Two private parcels of land are surrounded by the Project and are not a part of the Project, as shown on Figure 2. Access to these parcels of land would be provided via the arterial roadway system within the Project.

A known fault (the Yuha Wells fault) traverses a portion of the Project Site from the southwest to the northeast. Also, an existing SDG&E transmission line traverses the site from the northwest to the southeast. North of the site is the USG Corporation Gypsum Wallboard Manufacturing Facility (known as Plaster City), which is located on Evan Hewes Highway approximately 3 miles west of the intersection of Dunaway Road and Evan Hewes Highway.

The ground surface at the Solar Two Project Site slopes northeast. The western portion of the Project Site (west of the SDG&E transmission line) is characterized by rolling terrain with well-defined washes. East of the SDG&E transmission line, the terrain has uniform and gentle slopes.

The area adjoining the Project is primarily undeveloped recreational desert land. Other land uses in the area surrounding the Project Site include BLM-administered public land zoned for multiple use, and private land containing agricultural, residential, and industrial uses. The Yuha ACEC is south of Interstate 8 (Figure 1).

3.2 Biological Setting

The approximately 6,465-acre Project Site is located in the Colorado Desert in gently rolling open terrain dominated by desert scrub vegetation. The Colorado Desert is the western portion of the larger Sonoran Desert that extends across the southwestern United States and into Mexico. The climate is very hot and dry in the summer months, and cool and moist in the winter. Perennial and intermittent rivers and streams are rare, and most water flow occurs as flood flows within defined washes and less defined flood-flow paths during rare major winter rain

events. Habitats in this region of the Colorado Desert vary with the landscape and precipitation levels. The area to the east of the Project Site supports irrigated agricultural lands, to the south is I-8 and undeveloped Sonoran creosote bush scrub within Yuha Desert Area of Critical Environmental Concern, to the west is undeveloped Sonoran creosote bush scrub, and to the north is the BLM off-highway vehicle (OHV) Area. With the exception of the Plaster City plant just north of the Project, a maintained dirt access road along the transmission line, and several OHV trails, the Project Site is relatively undisturbed, with chronic OHV activity focused along roads and within major washes (Figure 8).

3.3 Vegetation Communities Present

Vegetation on-site (Figure 7) consists of a single vegetation community: Sonoran creosote bush scrub, as mapped according to the Holland Code (1986). Disturbed areas are mostly limited to dirt roads and OHV trails that traverse the Project Site. The creosote bush scrub is in a disturbed condition along the northern Project boundary within the 1-mile buffer areas assessed. Table 5, Vegetation Types Occurring within the Solar Two Project Boundary and Off-Site Transmission Line and Waterline, shows the estimated existing vegetation acreages for areas within the Project Site boundary, within the 500-foot buffer of the off-site transmission line and within the 500-foot buffer of the off-site waterline.

Sonoran creosote bush scrub (Holland Code 33100) is a low-growing desert plant community dominated by creosote bush (*Larrea tridentata*), bursage (*Ambrosia dumosa*), brittlebrush (*Encelia farinosa*), and several species of cactus. Creosote bush is a drought-tolerant deciduous shrub frequently found on desert bajadas, alluvial fans, and on well-drained desert soils. This vegetation type is common throughout Southern California desert areas and is the basic creosote scrub of the Colorado Desert (Holland 1986). Other plant species observed within this habitat on-site include tamarisk (*Tamarix* sp.), ocotillo (*Fouquieria splendens*), silver cholla (*Opuntia echinocarpa*), and mesquite (*Prosopis* sp.). Shrub density ranges from moderate to low density (shrub spacing from several feet to tens of feet). Substrates on which this vegetation type was observed on-site include desert pavement, coarse sand, and sandy wash. Sparse stands of tamarisk and mesquite mixed with creosote scrub are primarily concentrated within several dry washes that transect the property. No other distinct vegetation communities occur along the off-site transmission line or waterline.

3.4 Special Management Areas

Several flat-tailed horned lizard Management Areas (MA) and one research area (RA) occur throughout the project vicinity including the Yuha Desert MA, which is also a designated ACEC,

East Mesa MA, West Mesa MA, Borrego Badlands MA, and Ocotillo Wells State Vehicular Recreation Area RA (Figure 1). These management areas are controlled by multiple agencies including federal non-military, federal military, state, and private in-holdings (FTHL ICC 2003). The goal of these management and research areas is to maintain stable, self-sustaining populations of the flat-tailed horned lizard and other wildlife and to promote research and conservation of sensitive species through effective protection, habitat management and enhancement, and compensatory mitigation.

Section 4 Flat-Tailed Horned Lizard

4.1 Species Description and Range-Wide Status

4.1.1 Listing Status

The flat-tailed horned lizard was designated a sensitive species in California by the BLM in 1980. In 1993, the U.S. Fish and Wildlife Service (USFWS) proposed listing the lizard as a threatened species. Since then, the species has been proposed for listing three times by the USFWS, which has each time subsequently withdrawn the listing proposal. In 2003, the Center for Biological Diversity (CBD) filed suit against the USFWS in response to the 2001 withdrawal. A federal court ruled in 2005 that the USFWS withdrawal of its proposed rule was a violation of the Endangered Species Act. In 2006, the USFWS again withdrew its proposal to list, and another suit was filed by CBD et al. The second withdrawal was upheld by the court in 2007, and the CBD and allies appealed. In 2009, the Ninth Circuit Appeals Court ruled that the Service's decision to deny FTHL protection was illegal and ordered the Service to reconsider listing the species (CBD 2009). On November 2, 2009, a judge ruled that 2006 decision to withdraw the proposed rule is vacated and remanded to the Service and a new final listing rule must be completed within 12 months. The 1993 proposed rule is reinstated, therefore, the FTHL is considered as a proposed threatened species (USFWS personal communication 2009).

4.1.2 Species Description

The flat-tailed horned lizard has a flat, rounded body with prominent horns on the back of its head and a distinctive black stripe and four round spots on its back. This species lacks external ear openings, has a long, flattened tail and two rows of lateral fringe scales, distinguishing it from the desert horned lizard which co-occurs with the FTHL. The desert horned lizard differs from the flat-tailed horned lizard by its single row of lateral fringe scales, lack of dorsal stripe, differing arrangement of cranial horns, and more mottled coloration (Brown 2009). Both species display cryptic coloration and tend to remain motionless when approached, making them very difficult to detect in the field. Both sexes display umbilical scars, but only males have enlarged post-anal scales. Average snout-vent length for adult FTHL is between 65 and 80 mm, with hatchlings ranging between 30 and 38 millimeters (mm) (FTHL ICC 2003).

4.1.3 Distribution

The flat-tailed horned lizard has a very limited distribution in the lower Colorado River region in portions of San Diego, Imperial, and Riverside counties in California, southwestern Arizona, and northern Baja California and Sonora in Mexico. In California, the range of this species extends from the Coachella Valley southeast to the Imperial and Borrego Valleys, where it occurs in Anza Borrego State Park to the west and Glamis and Ogilby to the east (Rorabaugh and Young 2009). The species has been extirpated from much of the Coachella and Imperial Valleys and other intensively developed areas. Individual home range can be highly variable, but where density is high, home ranges tend to be smaller (Rorabaugh and Young 2009). Individual home ranges for this species are unusually large for their size with an average home range of approximately 6.7 acres (FTHL ICC 2003).

4.1.4 Habitat Affinities

The flat-tailed horned lizard inhabits areas of fine sand in desert washes and flats in the Lower Colorado River Valley Subdivision of Sonoran Desert Scrub. This lizard typically occurs in flat sparse desert scrub habitats dominated by creosote bush and bursage on fine, sandy, alkaline soils. However, this species has also been observed on sandy flats and hills, badlands, salt flats, and gravelly soils. Several studies have found that while FTHLs may prefer sandy areas, they are not confined to such areas (Grant 2005). Several studies have found a positive correlation between the number of perennial shrubs and FTHL abundance, but it has been suggested that the relationship is not linear. In fact, high densities of perennials may support more FTHL predators such as round-tailed ground squirrels and loggerhead shrikes and low shrub density may help support ant populations (Grant 2005). Therefore, a sparsely vegetated landscape may be more suitable for this species.

Although the desert horned lizard occurs within the same range as flat-tailed horned lizards, subtle differences in the microhabitats used by each species have been observed. FTHLs seem to prefer areas supporting finer sand and level terrain with sparse creosote-bursage vegetation while desert horned lizards are frequently observed on more alluvial terrain dominated by washes containing small trees (FTHL ICC 2003).

4.1.5 Life History

Flat-tailed horned lizards have one of the most specialized diets of all horned lizard species (Rorabaugh and Young 2009). Turner and Medica (1982) found that over 97 percent of total food intake for flat-tailed horned lizards was composed of ants in specimens studied. Harvester ants (*Veromessor pergandei*, *Polonomyrex californicus*, and *P. magnacantha*), and pyramid

ants (*Conomyrma insane*) composed 75 and 16 percent of the lizards' diet, respectively. As a result, *Phrynosoma* scat is distinctive from other lizard genus scat in that it is fragile, cylindrical, and composed of ant body parts. Among Phrynosoma genera that occur in the same range, scat cannot be easily determined to species.

Mating for the flat-tailed horned lizard typically occurs in May and June and females have been observed traveling far from their home range to deposit eggs in burrow (Rorabaugh and Young 2009). Three to seven hatchlings per clutch emerge from July through October, with two clutches typically laid when food resources are abundant. Hatchlings reach sexual maturity by the following spring when ants are abundant. This species is active throughout the day in spring and fall with activity limited to morning and evening in the summer. Nights are usually spent exposed on the surface or in a shallow burrow. Burrows or shade from bushes is used during the mid-day summer heat as well. FTHLs are typically dormant from mid-November until mid-February and hibernate in burrows they create within 5 cm from ground surface. Individual FTHLs typically live 4 years, with lifespans of up to 6 years recorded in the Yuma MA (FTHL ICC 2003).

4.1.6 Population Trends

The main factors that influence flat-tailed horned lizard population dynamics include prey availability, vegetative cover, substrate, and OHV activity (Grant 2005). Horned lizard densities appear to fluctuate greatly between years and in correlation with winter/spring precipitation and prey availability. Increased rainfall leads to increased production of annual plants and the availability of seeds for harvester ants to collect, thus increasing the number of ants available for FTHLs to prey upon (FTHL ICC 2003). Because the availability of harvester ant colonies is strongly correlated with FTHL abundance, any negative effects on ant populations can indirectly affect FTHL populations as well (Grant 2005). Although accurate FTHL population densities are difficult to calculate, the species does appear to be declining regionally mainly due to habitat degradation.

4.1.7 Threats

It is estimated that up to 90 percent of the lizards' original geographic range is subject to, or potentially subject to, some form of human disturbance (Turner and Medica 1982). Approximately 50 percent of the remaining habitat within the FTHL range is estimated to be at risk of habitat conversion (Grant 2005). As of 2003, approximately 400,000 hectares of suitable habitat for the FTHL remained in California (FTHL ICC 2003). Flat-tailed horned lizards are suffering habitat loss due to OHV use and development.

Legal and illegal forms of OHV use are common within the FTHL range and can affect FTHL both directly and indirectly. Direct effects include mortality, destruction of burrows, and possible hearing damage. Indirect effects include alteration of vegetation, substrate, and prey densities (Grant 2005). Because desert soils are susceptible to compaction, chronic OHV use can affect the burrowing of FTHLs and the construction of ant nests. OHVs also affect plant density and can result in a degraded food base for FTHL prey species as well as decreasing overall plant cover that is used for shelter and sand accumulation (FTHL ICC 2003).

Approximately 43 to 50 percent of the species' habitat in the U.S. has been converted to agricultural and urban development with much of the remaining habitat disturbed by human activity (Rorabaugh and Young 2009). Agriculture is a prominent industry in much of the FTHL's range, including the Imperial Valley. Conversion to agricultural land and other land uses eliminates FTHL habitat and potentially attracts predators to adjacent suitable areas. The continued development of suitable habitat in the Imperial Valley has slowed in recent years due to the limitations of water supply (FTHL ICC 2003).

Urban development also results in direct impacts to habitat in the form of construction of homes and buildings, landscaping, creation of parks and golf courses, and road construction. Habitat adjacent to urban development is affected by OHV use, spread of non-native vegetation, and enhancement of predator populations, such as domestic animals and ravens. The construction and use of roads in or adjacent to suitable FTHL habitat increases road mortality and creates potential barriers for FTHL movement. Railroads and irrigation canals can also impede FTHL movement (FTHL ICC 2003).

Other threats to this species include increased predation from ground squirrels, ravens, loggerhead shrikes, and American kestrels, and increased density of invasive weeds that degrade suitable habitat, especially near developed areas.

4.1.8 Critical Habitat

No critical habitat has been proposed for this non-listed species. However, several flat-tailed horned lizard management and research areas have been established throughout Imperial County including the Yuha Desert MA, East Mesa MA, West Mesa MA, Borrego Badlands MA, and Ocotillo Wells Research Area. These management areas are controlled by multiple agencies including federal non-military, federal military, state, and private in-holdings (FTHL ICC 2003). The goal of these management and research areas is to maintain stable, self-sustaining FTHL populations and encourage research that promotes conservation of the species through effective protection, habitat management, and compensatory mitigation.

4.1.9 Synopsis of Status

The status of the flat-tailed horned lizard is difficult to assess due to the challenges of locating and studying this cryptic species. This species is currently a federally proposed threatened species (USFWS 1993). Flat-tailed horned lizard populations continue to be studied by the agencies to determine the best way to protect this species and its habitat.

4.2 Occurrence and Status of Flat-Tailed Horned Lizard on Site

URS Corporation (URS) biologists were trained in tracking and surveying for flat-tailed horned lizards by biologists from the BLM El Centro Field Office. CDFG and BLM protocol surveys for flat-tailed horned lizards were conducted between May 1 and July 11, 2007 and May 5 and May 7, 2008. A 26-acre grid pattern was laid over the project map. Four hectare survey plots were centered within each 26-acre grid cell for a total of 332 plots. Each plot was surveyed for one hour (Figure 8). In this manner, the entire Project Site was evenly sample-surveyed at 38 percent coverage. For the 2008 flat-tailed horned lizard surveys, BLM requested that the transect survey protocol be applied to the two off-site linear Project features (waterline and transmission line). During transect survey protocol surveys, four transects were surveyed on each side of the linear Project feature center-line. All horned lizard sign, including live and deceased flat-tailed and desert horned lizards, scat, and tracks were mapped and recorded with handheld GPS units. Photographs of horned lizards were taken, and survey forms were completed for each horned lizard sighting. Any horned lizards that were incidentally encountered during other survey efforts were also documented.

Two flat-tailed horned lizards were detected along the eastern boundary, one within the Project Site and one just outside, and four desert horned lizards were detected in the Project Site during 2007 focused surveys. Two deceased flat-tailed horned lizards were observed along the off-site transmission line in 2007. One flat-tailed horned lizard and two desert horned lizards were detected on the Project Site during 2008 focused surveys (Figure 9). Based on the Project Site size, 38 percent protocol survey coverage, and an assumed 25 percent detection rate for protocol surveys, it is estimated that approximately 20 to 30 flat-tailed horned lizards may occupy the Project Site where suitable habitat is present (2/[0.38 x 0.25] = 21; 3/[0.38 x 0.25] = 32). It is essential to note that the assumed detection rate could be in error and the actual detection rate may be considerably lower.

Active harvester ant mounds and horned lizard scat were observed throughout the site. Because the desert horned lizard also inhabits the area, it was not possible to determine which species of horned lizard produced the scat. Suitable habitat for the flat-tailed horned lizard is

present throughout the 6,500 acre site, along the off-site transmission line, and on the portion of waterline west of the West Main Canal. However the results of the protocol surveys of the site suggest that the Solar Two site may support much lower densities compared to optimal habitat plots being monitored in the FTHL MAs.

4.2.1 Population Density within FTHL MAs

Because population density of flat-tailed horned lizards is difficult to assess due to the difficulty of finding and observing the species, BLM staff requested that the population size on the Project site be estimated using the MA density plot data from optimal FTHL habitat.

Several different strategies for calculating FTHL density have been used, including counts of lizards and/or scat, distance sampling, closed mark-recapture estimation, and radio telemetry. Lizard and scat counts are generally not accurate because of the low detectability of the species, differing rates of scat deposited during wet and dry years, and the inability to distinguish FTHL scat from other sympatric horned lizard species (Grant and Doherty 2007). Distance sampling in the Yuha Desert MA in 2004 estimated a FTHL population between 5,321 and 18,798 lizards. Mark-recapture data for the same area suggested a FTHL population between 10,738 and 163,635 lizards. A rough estimate of FTHL numbers in the Yuha Desert DWMA is approximately 25,000, or two lizards per hectare (Grant 2005). Data collected by the BLM from 2007 to 2009, and analyzed in 2009, found that the overall FTHL population density within all MAs monitored was 3.43 individuals per hectare, and 3.35 per hectare in the Yuha Desert MA (Kristan 2009). These numbers were estimated using 9-hectare sample plots as opposed to the 4-hectare plots used in 2004 by Grant (2005).

The Solar Two site is not considered optimal habitat due to habitat isolation and edge effects associated with the existing highways, railroad, Plaster City, and chronic disturbance by OHV activity within preferred habitat (sandy washes). About 20 percent of the site is dominated by desert pavement that supports less food resources and sandy areas preferred by FTHL.

URS used the optimal habitat FTHL density estimates (Grant 2005, Kristan 2009) as the basis to calculate an estimated density on the Project site. A rough estimate of FTHL density on site could be one lizard per hectare (about 2,600 lizards), which is half of the density estimate of two lizards per hectare reported by Grant (2005). The site was judged by URS in this rough estimate to be half of the habitat quality of that found in the MAs. This rough estimate was obtained by multiplying the Project acreage (approximately 2630 ha) by the density (one lizard per hectare) and rounded to the nearest 100.

Using the same reasoning with the density estimates obtained by Kristan (2009) for the Yuha Desert MA yields a rough population estimate of 4,400 lizards [3.35 lizards per hectare x 50% for habitat quality x 2630 hectares, rounded to the nearest 100]. Using Kristan's estimate for all MAs in California (3.43/ha), a rough estimate of the population size on the Project site would be 4,500 lizards.

The low number of FTHL detections during 332 4-hectare protocol plot surveys suggests that the FTHL population on the project site may be much less than density estimates extrapolated from surveys of optimal FTHL habitat. If the site supports 2,600 individuals, and the detection rate was 25% then it would have been expected that 650 FTHLs would have been detected during the protocol surveys of the site. In addition, a portion of the habitat on site (approximately 20 percent) occurs on desert pavement that supports only sparse vegetation, less sandy substrate, and fewer harvester ant colonies. Studies have shown that although FTHLs may prefer sandy substrates, they are not confined to them (Grant 2005). However, because low ant density negatively affects horned lizard populations, areas with low ant densities would not support as many FTHLs (Grant 2005). Accounting for the amount of less suitable habitat (20 percent) on site would reduce the rough estimate of the population to approximately 2,100 lizards (2600 x 0.8). Using the Kristan densities as a baseline, the estimate would be 3,500 – 3,600 lizards.

Applying different judgments of the habitat suitability on the Solar Two site compared to the Management Areas provides a large range of rough estimates of population size:

- 50% of Kristan (2009): 1.7 FTHL/ha = ~4400 x 80% habitat suitability onsite = approximately 3,500
- 25% of Kristan (2009): 0.84 FTHL/ha = ~2200 x 80% habitat suitability onsite = approximately 1,800
- 10% of Kristan (2009): 0.34 FTHL/ha = ~900 x 80% habitat suitability onsite = approximately 700
- 50% of Grant (2005): 1.0 FTHL/ha = ~2600 x 80% habitat suitability onsite = approximately 2,100
- 25% of Grant (2005): 0.5 FTHL/ha = ~1300 x 80% habitat suitability onsite = approximately 1,100
- 10% of Grant (2005): 0.1 FTHL/ha = ~260 x 80% habitat suitability onsite = approximately 210

The actual population size of FTHL associated with the proposed Solar Two site cannot be determined with any degree of certainty. However, incidental take based on loss of suitable habitat is approximately 6,500 acres, which represents about 1.7 percent of documented suitable habitat in California (FTHL ICC 2003).

4.3 Effects of the Project on Flat-Tailed Horned Lizard

4.3.1 Direct Effects

Potential adverse effects to the flat-tail horned lizard and its habitat would occur as a result of the Project. Flat-tailed horned lizards have been detected at two locations along the eastern boundary, one within the Project Site and the other outside of the Project Site, and two locations along the off-site transmission line. They are presumed to occur throughout, but with fewer or none on areas of desert pavement. Mortality due to roadkill during construction and ongoing operation and maintenance activities, ground disturbance associated with road and facility installation, and loss of suitable forage habitat are the most likely effects to flat-tail horned lizards. In addition the use of the Soil Dust Stabilizer Soiltac may be potentially toxic to the flat-tailed horned lizard as well as inhibit their ability to burrow in the sand. Regular washing of the SunCatchers may result in Soiltac washing into habitats adjacent to the project site. Clearance surveys would be conducted before each phase of construction to minimize mortality of individual horned lizards. Areas not directly used for installation of the SunCatcher solar groups would be avoided. In addition, appropriate BMP measures would be implemented to minimize potential effects to flat-tailed horned lizard where deemed practicable.

Permanent impacts associated with the offsite transmission line will occur from the installation of approximately 70-75 80-ft tall transmission poles. The impact area for installation of each pole would be less than 0.25 acre, assuming a 100’ x 100’ construction area for each pole, resulting in a potential impact of approximately 19 acres of the total 6,500 acres. Potential effects to flat-tailed horned lizards caused by construction of the off-site transmission line include habitat disturbance associated with installation of towers and access spur roads to the tower sites, and maintenance activities. Potential long-term effects include ongoing use of the existing access road, enhanced non-native vegetation along the road edge and between tower sites, and reduced vegetation cover under the towers (FTHL ICC 2003). Because the transmission line would be placed along an existing access road, effects to horned lizard habitat would be minimized.

Potential effects to flat-tailed horned lizards caused by the waterline construction include habitat disturbance from trenching, stockpiling of fill, refilling the trench, and moving vehicles along the

corridor during construction and maintenance (FTHL ICC 2003). The off-site waterline is proposed to be constructed within the existing highway ROW that has been previously disturbed. Approximately 5.8 acre of suitable habitat for the FTHL is present along the off-site waterline. The potential for flat-tailed horned lizard mortality from vehicle usage along access roads would also be expected where occupied habitat is adjacent to these roads.

Approximately 6,500 acres of FTHL suitable habitat would be directly affected by the project. This represents 1.7 percent of the estimated amount (400,000 acres) of suitable habitat occurring in California.

4.3.2 Indirect Effects

Possible indirect effects to flat-tailed lizards caused by project construction, operation, and maintenance include: attraction of predators such as round-tailed ground squirrels, and enhanced perching opportunities for ravens, loggerhead shrikes, and American kestrels. Introduction of invasive weeds, increased road mortality, and habitat degradation adjacent to construction areas are also potential indirect impacts to FTHL (FTHL ICC 2003).

4.3.2.1 Connectivity

The project site is bordered to the north by the Evan Hewes Highway (S80) and a railroad, and to the south by I-8. Roads and railroads can be physical barriers to movement. Road mortality can also decrease the probability of movement by depressing population densities along roads. FTHL lizard populations have been found to be severely impacted along well-traveled roads (FTHL ICC 2003). Along Highway 98 in Imperial County, for example (Grant et al. 2001) 87% fewer FTHL individuals were detected within 0.45 mile (2,380 feet) of the road as compared to areas farther away. Young and Young (2000) suggested FTHL populations would be affected within 0.3 mile (1,580 feet) of a road, with severe impacts within 0.15 mile (790 feet). In addition to traffic-related deaths, lizards can be subject to increased predation from birds such as ravens, loggerhead shrikes, and American kestrels perching along utility lines and fences associated with roads. Barrows et al. (2006) documented significant effects on FTHL density up to 150 m (490 feet) from roadways, which they attributed to vehicle traffic related deaths and bird predation. FTHL individuals, which are cryptically colored in their natural habitat, would become conspicuous against the pavement of roadways, making them especially vulnerable to predation. Opportunistic predators such as ravens may be attracted to roadways because of availability of roadkill. FTHL may also avoid roads and road edges because of lack of suitable habitat, including food sources and shelter.

Surface Connectivity Across S80 and the Railroad

County road S80 is a two lane road with a pavement width of about 30 feet. At-grade crossing of S80 by FTHL would be limited by poor habitat quality, increased visibility to predators, and traffic-related mortality. A transmission line along the north edge of S80 provides roosting opportunities for avian predators that may further reduce the probability of successful movement across the road right of way. Some movement of FTHL across a two-lane road is likely (Barrows et al. 2006), but road-related mortality has likely already depressed the local population density and thus limited the number of individuals present in the road vicinity to potentially move to the other side.

At grade crossing of the railroad by FTHL is limited somewhat by the slopes and components of the roadbed and track.

Culvert Connectivity Across S80 and the Railroad

In a February 2007 culvert study (Appendix _), URS Corporation biologists found seven culverts under the stretch of S80 along the approximately 7-mile northern edge of the project site. All of these are large culverts or trestles with sandy bottoms that FTHL could easily pass through.

Surface Connectivity Across I-8

I-8 is a divided highway with two eastbound lanes and two westbound lanes, with an approximately 90-foot wide median. Total width of pavement is about 80 feet. The total width of the roadway, including the pavement, road shoulders and median, varies from 180 to about 200 feet. This is a major highway between the San Diego area and the Imperial Valley, and is well-traveled throughout the day when FTHL are active.

At grade crossing of I-8 would be impeded by vehicle traffic across the four lanes, avoidance of the road edge and road due to lack of habitat, increased visibility to predators throughout the 80-foot paved width of the four lanes, and also by an asphalt concrete curb along the north edge of the westbound lanes. The slow movements characteristic of FTHL and its tendency to remain motionless when startled would make movement across four lanes of daytime traffic unlikely. Right-of-way fencing north and south of the freeway likely provide perching for avian predators that would further reduce the probability of successful movement across the road right of way. Cut and fill slopes impede movement to and from the roadway. Given all of these factors, combined with a likely depressed FTHL population density along this major desert roadway, very little at grade movement of FTHL across I-8 is expected.

Culvert Connectivity Across I-8

In a February 2007 culvert study (Appendix _), URS Corporation biologists evaluated all culverts under I-8 along the southern border of the project site. Along the 7 mile stretch of road, they found a single culvert ("Box Culvert 8") that was determined to be completely passable by FTHL. Two additional culverts ("Box Culvert 13" and "Box Culvert 14") were determined to be accessible by FTHL from the project side but not from the south side of I-8. These culverts are approximately 220 feet long.

Voluntary passage of FTHL through a 220-foot culvert would be unexpected due to this species' usual sedentary habits and the absence of foraging habitat within and immediately adjacent to the culvert. Also, the low light conditions in a 220-foot culvert would likely be unattractive to this diurnal species that typically remains at the soil surface or enters only shallow or straight burrows (FTHL ICC 2003). Painter and Ingraldi (2007) did, however, find limited movement of FTHL under artificial conditions through a 40-foot, 24-inch diameter culvert.

Connectivity Through the Site Interior

Connectivity through the interior of the project site is relatively unimpeded. The few dirt roads on the site may attract individuals that are subject to greater risk of mortality from being run over by vehicles. An existing transmission line running diagonally through the western half of the site (Appendix _: Figure 1) may provide nesting and roosting opportunities for avian predators.

Combined Connectivity

Existing roads, railroad, fences, transmission lines, and ground disturbance impede FTHL movement across the project site between habitat areas to the north and south. Connectivity across I-8 is severely limited due to the absence of passable culverts and to impediments to at grade crossing, creating a nearly complete barrier to FTHL movement between the Yuha Desert Management Area and the proposed project site. S80 and the railroad are somewhat less constraining on movement between the project site and habitat areas to the north. Both I-8 and S80 likely create zones of depressed population density due to traffic and predator related mortality of individuals along these roadways. FTHL is also a relatively sedentary species with limited movement patterns, further decreasing the probability of movement across areas of unsuitable or marginally suitable habitat bordering the project site. Because of the combined effects of these impediments, movement of FTHL individuals or lineages across the project site between habitat areas to the north and south would be expected only at very low frequency.

Expected Project Impacts on Connectivity

No project-related alterations to existing culverts, I-8, S80, or the railway are proposed. Thus, the project is not expected to directly affect connectivity via culvert or at grade crossing of these roads or the railroad. However, the project is expected to further degrade habitat conditions and reduce FTHL population density within the project site as described above. The reduced habitat quality would be an additional impediment to movement within the site. Due to the reduced population density, there would also be fewer individuals to potentially attempt movement from the site to habitat areas to the north or south. Project impacts would thus be expected to further decrease the already low probability of FTHL movement between habitat areas north and south of the site.

4.4 Mitigation and Minimization Measures for Flat-Tailed Horned Lizard

Because the approximately 6,500-acre site would be impacted by development of the Solar Two Project, compensation in the form of the purchase of suitable FTHL habitat off site is proposed at a 1:1 ratio. Each acre of habitat lost to solar development on the site would be replaced by one acre of habitat off site. Since a portion of the transmission line passes through the Yuha Desert MA, impacts to suitable FTHL habitat within the MA would be mitigated at a 5:1 ratio. In addition, the mitigation and monitoring measures listed below would be implemented upon Agency approval. The off site land chosen by the BLM for FTHL mitigation will also serve to mitigate for impacts to ACOE and CDFG jurisdictional waters. The specific private parcels for off site compensation have yet to be determined by the BLM.

Solar Two would provide in lieu fees to the BLM rather than purchase the compensation lands. Lands to be acquired will be identified by BLM once they have determined the distribution of "willing seller" parcels. The top priorities for acquisition of compensation habitat are lands within the Yuha Desert MA, followed by lands within the West Mesa MA.

Tessera Solar/Stirling Energy Systems will be responsible for maintaining records and reporting compliance with the measures outlined in Section 4.4.1. Annual reports will be submitted to the BLM, USFWS, Corps, CDFG, and the RWQCB.

In addition to the $5.9 million mitigation fees to offset impacts to the FTHL, the proposed project will comply with additional measures including raven management and reduced speed limits on road ways within the proposed project site.

The following mitigation and minimization measures to avoid impacts due to ravens include:

- Trash and discarded food items will be promptly contained within closed, raven-proof containers. Container contents will be regularly removed from the construction site to reduce the attractions to ravens and other predators of FTHL;
- Regular monitoring and removal of raven nests along the transmission line;
- Construction of evaporation ponds so that they don't provide water and perching subsides; and
- Installation of bird avoidance devices to prevent perching on perimeter fencing.

In addition to the purchase of offsite compensation lands, the mitigation and monitoring measures listed below would be implemented upon Agency approval.

4.4.1 Compliance with the Flat-Tailed Horned Lizard Rangewide Management Strategy

The Flat-tailed Horned Lizard Rangewide Management Strategy was prepared by federal, state, and local governments to provide guidance for the management and conservation of flat-tailed horned lizards and their habitat. The Strategy requires compliance with the following mitigation measures:

1. To the extent possible, surface-disturbing projects shall be located outside of FTHL MAs and the RA, and shall be timed to minimize mortality. If a project must be located within a MA or RA, effort shall be made to locate the project in a previously disturbed area or in an area where habitat quality is poor. A survey of the project site shall be conducted prior to construction in order to assist in locating the project.

The Project would comply with this measure. With the exception of the offsite transmission line, the Project site is outside of any MAs. The offsite transmission line occurs adjacent to an existing transmission line and would utilize the same ROW and access road. Preconstruction clearance surveys would be conducted 30 days prior to ground disturbance. Only persons authorized by the CDFG and BLM shall conduct the surveys and handle the lizards. Ten, one-hour presence/absence surveys per section shall be conducted prior to construction. Any encountered horned lizards would be relocated to a designated area offsite .

2. Prior to project initiation, an individual shall be designated as a field contact representative. The field contact representative shall have the authority to ensure

compliance with protective measures for the FTHL and would be the primary agency contact dealing with these measures. The field contact representative shall have the authority and responsibility to halt activities that are in violation of these terms and conditions.

The Project would comply with this measure. A qualified biologist authorized by the BLM and the CDFG who shall have experience in surveying for FTHLs, including ability to recognize and follow FTHL tracks, or shall obtain training form an experienced investigator would be assigned to monitor the site during all stages of construction and would be designated as the field contact representative.

3. All project work areas shall be clearly flagged or similarly marked at the outer boundaries to define the limit of work activities. All construction and restoration workers shall restrict their activities and vehicles to areas that have been flagged to eliminate adverse impacts to the FTHL and its habitat. All workers shall be instructed that their activities are restricted to flagged and cleared areas.

The project complies with this measure. All construction workers would be instructed to work only in those areas designated by the qualified biologist.

4. Within FTHL habitat, the area of disturbance of vegetation and soils shall be the minimum required for the project. [If possible, specify a maximum disturbance allowable based on the specifics of the project.] Clearing of vegetation and grading shall be minimized. Wherever possible, rather than clearing vegetation and grading the ROW, equipment and vehicles shall use existing surfaces or previously disturbed areas. Where grading is necessary, surface soils shall be stockpiled and replaced following construction to facilitate habitat restoration. To the extent possible, disturbance of shrubs and surface soils due to stockpiling shall be minimized.

Clearing and grading will be minimized. Approximately two-thirds of the site's vegetation would be mowed for Project construction. About one-third of the site would retain intact native vegetation. Surface soil stockpiling and re-use has not been described by Solar Two.

5. Existing roads shall be used for travel and equipment storage whenever possible.

The project would comply with this measure. Existing roads would be used to the maximum extent possible.

6. Where feasible and desirable, in the judgment of the lead agency, newly created access routes shall be restricted by constructing barricades, erecting fences with locked gates at road intersections, and/or by posting signs. In these cases, the

project proponent shall maintain, including monitoring, all control structures and facilities for the life of the project and until habitat restoration is completed.

The solar plant site will be surrounded by a permanent security fence in order to control traffic and access for authorized personnel only onto the site for the life of the project.

7. A biological monitor shall be present in each area of active surface disturbance throughout the work day from initial clearing through habitat restoration, except where the project is completely fenced and cleared of FTHLs by a biologist (see Measure 8). The biological monitors shall meet the requirements set in Appendix 6 of the FTHL ICC. The monitor(s) shall perform the following functions:

    a. Develop and implement a worker education program. Wallet-cards summarizing this information shall be provided to all construction and maintenance personnel. The education program shall include the following aspects at a minimum: biology and status of the FTHL, protection measures designed to reduce potential impacts to the species, function of flagging designating authorized work areas, reporting procedures to be used if a FTHL is encountered in the field, and importance of exercising care when commuting to and from the project area to reduce mortality of FTHLs on roads.

    b. Ensure that all project-related activities comply with these measures. The biological monitor shall have the authority and responsibility to halt activities that are in violation of these terms and conditions.

    c. Examine areas of active surface disturbance periodically (at least hourly when surface temperatures exceed 85ºF) for the presence of FTHLs. In addition, all hazardous sites (e.g., open pipeline trenches, holes, or other deep excavations) shall be inspected for the presence of FTHLs at least once per day during warm periods and prior to backfilling.

    d. Work with the project supervisor to take steps, as necessary, to avoid disturbance to FTHLs and their habitat. If avoiding disturbance to a FTHL is not possible or if a FTHL is found trapped in an excavation, the affected lizard shall be captured by hand and relocated.

The project would comply with these measures. A qualified biologist/monitor approved by BLM would be present during active surface disturbance, a worker education program would be implemented, and any FTHLs observed prior to or during ground disturbance would be relocated to a designated area offsite.

8. Sites of permanent or long-term (greater than one year) projects in MAs where continuing activities are planned and where FTHL mortality could occur, may be enclosed with FTHL barrier fencing to prevent lizards from wandering onto the project site where they may be subject to collection, death, or injury. Barrier fencing should be in accordance with the standards outlined in Appendix 7 of the FTHL ICC. After clearing the area of FTHLs, no on-site monitor is required (see Measure 7).

BLM has discussed this mitigation measure with the FTHL ICC and for this project the agencies have agreed that FTHL exclusionary fencing would not be practicable. Due to the extremely cryptic nature of FTHLs, the probability detecting lizards is very low. Due to the large size of the project, it is highly likely that erecting exclusionary fencing would serve to trap FTHLs and other small animals in the work areas. Exclusion fencing would serve to further block movement of FTHLs and other small animals across this area.

9. The project proponent shall develop a project-specific habitat restoration plan under approval by the lead agency. The plan shall consider and include as appropriate the following methods: replacement of topsoil, seedbed preparation, fertilization, seeding of species native to the project area, noxious weed control, and additional erosion control. Generally, the restoration objective shall be to return the disturbed area to a condition that would perpetuate previous land use. The project proponent shall conduct periodic inspection of the restored area. Restoration shall include eliminating any hazards to FTHLs created by construction, such as holes and trenches in which lizards might become entrapped. Disturbance of existing perennial shrubs during restoration shall be minimized, even if such shrubs have been crushed by construction activities.

Upon the facilities decommissioning, a restoration plan would be necessary to restore the project site to pre-project conditions or better. At the time of decommissioning the owner of the facility will be the responsible party. The proponent for this project must submit a bond or other form of surety adequate for complete restoration of the site in order to obtain the right of way for the project. This bonding will ensure there is funding available for reclamation in the event anything happens to the company.

10. Construction of new paved roads may include a lizard barrier fence on each side of the road that is exposed to occupied FTHL habitat. Exceptions may occur in accordance with the following evaluation, to be applied separately to each side of the road. This prescription may also be applied to canals or other fragmenting projects:

    - Compensate for the entirety of the fragmented parcel, or

- Provide fencing and effective culverts or underpasses that would maintain connectivity.
- Provide fencing (no culverts). Specifications for barrier fences are provided in Appendix 7 of the FTHL ICC.

The Project would include paved roads within the ROW. Compliance with this measure would consist of compensation for the entirety of the fragmented parcels.

4.4.2 FTHL Relocation and Monitoring Plan

The Agencies have requested the implementation of a mark-recapture program for monitoring FTHL displaced by the Project. Any FTHL encountered during preconstruction surveys or construction monitoring would be captured, marked, and relocated by the project qualified biologist to a pre-determined area within the Yuha FTHL management area. The number of relocation sites will depend on the actual number of FTHLs relocated. The relocated FTHLs would then be monitored using methods outlined in the *Robust Pradel Mark-Recapture Protocol for Monitoring Flat-tail Horned Lizards on Sentinel Plots* (Grant 2006). The protocol calls for 9-hectare plots to be established at relocation areas. These plots would be surveyed by two teams of two qualified biologists authorized by the CDFG and BLM for nine consecutive days during the same period each year, preferably between April and October when ambient temperatures are between 35 and 40ºC (Grant 2006). Plots would be placed in areas of relatively high densities or where probability of observing FTHL is high. Captured lizards would be equipped with a Passive Integrate Transponder (PIT) tag as described in the protocol. Data collected on each lizard would include record date, snout-vent length, and if the lizard has been previously marked. Collected data would then be analyzed using the program MARK to estimate relative abundance (Grant 2006).

Section 5 Cumulative Effects

Cumulative effects analysis is conducted relative to any future State, tribal, local or private actions that are reasonably certain to occur in the future in the action area. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time (40 CFR 1508.7).

An analysis of cumulative effects relative to biological resources was completed in the Project's Application for Certification (AFC). This analysis concluded that since the project is not located within designated FTHL Management Areas and Areas of Critical Environmental Concern, which were designated by BLM to avoid significant cumulative impacts to biological resources, it would not contribute to a significant cumulative impact.

A supplemental cumulative effects analysis was conducted by Ecosphere Environmental Services (2009), which discussed cumulative effects on general biological resources, as well as 'sensitive' biological resources, including FTHL. Cumulative effects are on FTHL are discussed below in the context of this BA.

5.1 Flat-Tailed Horned Lizard

Based on a desktop analysis of GAP data performed by Ecosphere Environmental Services (2009), it was determined that approximately 17 percent of suitable habitat for FTHL in the Imperial Valley has been previously disturbed by development. The Solar Two Project would affect an additional 1.7 percent and other proposed projects in the vicinity would affect approximately 6 percent of suitable FTHL habitat.

Section 6 Conclusion

6.1 Determination of Effect on Flat-Tailed Horned Lizard

The Project may affect, and is likely to adversely affect flat-tailed horned lizard. Take would occur in the form of harassment, mortality, and loss of occupied habitat. Based on the amount of suitable habitat that would be impacted and assumed population densities based on studies from the Yuha Desert and other California MAs, approximately 2,100 FTHL may be affected by the proposed project. This may represent less than one percent of the estimated population within California. The proposed 6,500-acre project may affect about 1.7 percent of suitable habitat occurring within California.

Section 7 References

Barrows, C. W., M. F. Allen, and J. T. Rotenberry. 2006. Boundary processes between a desert sand dune community and an encroaching suburban landscape. Biological Conservation 131:486-494.

Brown, T.K. 2009. Desert Horned Lizard. Lizards of the American Southwest. Rio Nuevo Publishers. Tucson, AZ.

Center for Biological Diversity (CBD) 2009. http://www.biologicaldiversity.org/species/reptiles/flat-tailed_horned_lizard/index.html

Ecosphere Environmental Services. 2009. SES Solar Two, LLC Application for Certification Supplemental Cumulative Analysis.

Flat-tailed Horned Lizard Interagency Coordinating Committee (FTHL ICC) 2003. Flat-tailed Horned Lizard Rangewide Management Strategy, 2003 Revision.

Grant, T., M. McGrann, J. Neilans, and G. Wright. 2001. A mark-recapture pilot study of the flat-tailed horned lizard, Phrynosoma mcallii, in the Yuha Basin of southeastern California. BLM Rept., El Centro Resource Area, Calif.

Grant, T.J. 2005. Thesis: Flat-tailed horned lizards (*Phrynosoma mccallii*): population size estimates, effects of off-highway vehicles, and natural history. Colorado State University.

Grant, T.J. 2006. Robust Pradel mark-recapture protocol for monitoring flat-tailed horned lizards on sentinel plots. USFWS. December 12, 2006.

Grant, T.J. and P.F. Doherty, Jr. 2007. Monitoring of the flat-tailed horned lizard with methods incorporating detection probability. The Journal of Wildlife Management 71(4): 1050-1056.

Grinnell, J., and Swarth, H. S. 1913. An account of the birds and mammals of the San Jacinto area of southern California with remarks upon the behavior of geographic races on the margins of their habitats. Univ. Calif. Publ. Zool., 10:197-406.

Kristan, W.B. III, Ph.D. 2009. Flat-tailed Horned Lizard population estimates for the West Mesa, East Mesa, Yuma, and Yuha Basin Management Areas, 2007-2009. California State San Marcos. 7 pp. November.

Painter, M. L. and M. F. Ingraldi, 2007 – Use of Simulated Highway Underpass Crossing Structures by Flat-Tailed Horned Lizards (*Phrynosoma mcallii*), Final Report 594. Arizona Department of Transportation, Phoenix, Arizona.

Rorabaugh, J.C. and K.V. Young. 2009. Flat-tailed Horned Lizard. Lizards of the American Southwest. Rio Nuevo Publishers. Tucson, AZ.

SES Solar Two, LLC. 2008. Project Description and Plan of Development. [Not cited in BA].

Sherbrooke, W.C. 2003. Introduction to Horned Lizards of North America. University of California Press, Los Angeles, CA. [Not cited in BA].

Turner, F.B., and P.A. Medica. 1982. The distribution and abundance of the flat-tailed horned lizard (*Phrynosoma mcalli*). Copeia. 1982: 815-823.

USFWS. 2006. Endangered and Threatened Wildlife and Plants; Withdrawal of the Proposed Rule To List the Flat-Tailed Horned Lizard as Threatened. (50 CFR Part 17) 71 FR 36745. June 28, 2006. [Not cited in BA].

USFWS 1993. Endangered and threatened wildlife and plants: Proposed rule to list the flat-tailed horned lizard as threatened. Federal Register 58 (227):62624-62629.

Young, K. V., and A. T. Young. 2000. Final report: scientific study of the flat-tailed horned lizard, *Phrynosoma mcallii*. U.S. Dep. of Navy Contracts N68711-95-LT-C0032, N68711-95-LT-C0035.

7.1 Personal Communications

Engelhardt, T. 2009. Personal communication with Pat Mock of URS.

Section 8 Tables

Table 1: Major Equipment List

Description	Quantity	Size/Capacity	Remarks
SunCatcher power generating system	30,000	25 kWe	Focuses solar energy onto a Power Conversion Unit to generate 25 kWe of electricity
Generator collection sub-panel; distribution panel, 42 circuit, with circuit breakers in a weatherproof enclosure	2,500	400 A, 600 V	Collects the output from 12 Stirling dish assemblies (one 300-MW solar group). Each dish assembly connects to a 40-A, three-pole circuit breaker (36 poles).
Generator collection power center, distribution switchboard with six 400-A circuit breakers	500	2,000 A Bus, 600 V	Collects five 1.5-MW solar groups and connects one power factor correction capacitor group.
Collector group generator step-up unit (GSU) transformer, with taps	500	1,750 kVA, 575 V to 34.5 kV	Step up power from 1.5-MW solar group (60 Stirling dishes assemblies).
Power factor correction capacitor, switched in five each 200 kVAR steps	500	1,000 kVAR, 600 V	Provides power factor correction at the 1.5-MW solar group level.
Open bus switch rack, five 1,200-A feeder breakers, 40-kA INT, with switches, insulators, and bus work	5	34.5 kV, 3,000A	Each switch rack lineup collects 150 MW at 34.5 kV.
Shunt capacitor bank, switched in six 15-MVAR steps	5	34.5 kV, 90 MVAR	Provides power factor correction at the 150-MW solar group level.
Dynamic VAR (DVAR) compensation system in coordination with shunt capacitor banks; size to be determined by studies	1	34.5 kV, size to be determined	Provides active VAR compensation to maintain required power factor profile and to aid in meeting low-voltage ride-through requirements.
Disconnect switch, 35 kV, 200 kVBIL, group-operated	10	35 kV, 3,000 A	Provides capability to isolate power transformer from the 34.5-kV collection system.
Power transformer, three-phase, oil filled	5	120/160/200 MVA, 230/132.8 to 134.5/19.9 kV, 750 kV BIL	Step up power from 34.5-kV collection voltage to 230-kV transmission voltage.
Power circuit breaker	7	242 kV, 2,000 A, 40-kA interrupting capacity	Transformer and line protection.
Coupling capacitor voltage transformer	6	242 kV, 900 kV BIL, 60 Hz, PT Ratio 1,200/2,000:1	Voltage source for protection and control.

Table 1: Major Equipment List

Description	Quantity	Size/Capacity	Remarks
Disconnect switch, 242 kV, 900 kV BIL, group operated	10	242 kV, 2,000 A	For isolation of the power transformers, breakers and for isolating the substation from the interconnect transmission lines.
Diesel power generator set	1	250 kW, 480 V	Installed at Main Services Complex
Fire water pump, diesel	1	26 HP	Installed at Main Services Complex
Water Treatment	1	64,000 gpd	Automatic reverse osmosis system

Table Source: SES Solar Two, LLC, 2008.

Table Key: A = ampere (amp); BIL = basic impulse level; gpd = gallons per day; HP = horsepower; Hz = hertz; INT = international; kA = kilo amps; kV = kilovolt; kVA = kilovolt amps; KVAR = kilovolt amp reactive; kW = kilowatt; kWe = kilowatt-electric; MVA = mega volt amps; MVAR = mega volt amp reactive; MW = megawatts; V = volts; VAR = volt amp reactive; W = watts.

Table 2: Significant Structures and Equipment

Description	Quantity
SunCatcher power generating system	30,000
Main Services Complex administration building	1
Main Services Complex maintenance building	1
Main SunCatcher assembly building	3
Raw water storage tank, 175,000 gallons	1
Demineralized water tank, 175,000 gallons	2
Potable Water Tank, 17,000 gallons	1
230-kV transmission line towers, double-circuit with upswept arms	85 to 100
Generator collection sub-panel; distribution panel, 42 circuit, 400 A, 600 V, with circuit breakers in a weatherproof enclosure	2,500
Generator collection power center, 2,000-A distribution panels with six 400-A circuit breakers	500
Collector group generator step-up unit transformer (GSU), 1,750 kVA, 575 V to 34.5 kV, with taps	500
Power factor correction capacitor, 600 V, 1,000 kVAR, switched in five, each 200 kVAR steps	500
Open bus switch rack, 35 kV, 7 bay with five 35-kV, 1,200-A, 40-kVA INT, circuit breakers, insulators, switches, and bus work	5
Shunt capacitor bank, 34.5 kV, 90 MVAR switched in six each 15 MVAR steps	6
Dynamic VAR (DVAR) compensation system in coordination with shunt capacitor banks – size to be determined by studies	4
Disconnect switch, 35 kV, 3,000 A, 200 kV BIL, group-operated	5
Power transformer, three phase, 100/133/166.7 mega volt amp, 230/132.8-34.5/19.9 kV, 750 kV BIL, oil filled	5
Power circuit breaker, 242 kV, 2000A, 40 kilo amp interrupting capacity	7
Coupling capacitor transformer for metering, 242 kV, 900 kV BIL, 60 Hertz, Potential Transformer ratio 1,200/2,000:1	6
Disconnect switch, 242 kV, 2000A	10

Table Source: SES Solar Two, LLC, 2008.

Table Key: A = ampere (amp); BIL = basic impulse level; INT = international; kV = kilovolt; kVA = kilovolt amp; kVAR = kilovolt amp reactive; MVAR = mega volt amp reactive; v = volts.

Table 3: Water Usage Rates for Solar Two Project Operations

Water Use	Daily Average (gallons per minute)	Daily Maximum (gallons per minute)	Annual Usage (acre-feet)
Equipment Water Requirements			
SunCatcher mirror washing	10.4 (Table Note 1)	17.4 (Table Note 2)	14.2 (Table Note 3
Water Treatment System Discharge			
Brine to evaporation ponds	5.5	10.2 (Table Note 4)	7.5
Potable Water Use			
For drinking and sanitary water requirements	3.9 (Table Note 5)	4.7 (Table Note 6)	5.4 (Table Note 7)
Dust Control			
Raw water for dust control during operations	3.5 (Table Note 8)	6.9 (Table Note 9)	5.6 (Table Note 10)
Totals	**23.3**	**39.2**	**32.7**

Table Source: SES Solar Two, LLC, 2008.

Table Note 1: Based on 30,000 SunCatchers requiring a monthly wash with an average of 14 gallons of demineralized water per spray wash and a five-day work week (21 work days per month).

Table Note 2: During a 3 month period, all SunCatcher mirrors are given a scrub wash requiring up to three times the normal wash of 14 gallons per SunCatcher. Therefore, the Daily Maximum usage rate is based on two-thirds of the SunCatchers receiving a normal wash and one-third receiving a scrub wash.

Table Note 3: Based on every SunCatcher having approximately 8 normal washes per year with one additional scrub wash.

Table Note 4: Based on the maximum amount of demineralized water required for mirror washing and assumes a decrease in raw water quality requiring an additional 20 percent of system discharge.

Table Note 5: Assumes 30 gallons per person per day for 188 people.

Table Note 6: Maximum amount assumes a 20 percent contingency over the Daily Average.

Table Note 7: Assumes a six-day work week and average daily usage.

Table Note 8: Assumes 5,000 gallons per day.

Table Note 9: Assumes up to 10,000 gallons per day.

Table Note 10: Assumes daily average dust control operations.

Table 4: Estimated Disturbed Area Summary (Table Notes 1, 2)

Project Component Item	Area Construction Disturbance	Area Operations Permanent Disturbance	Proposed Length	Comments
Off-Site Development				
Off-site access road	4.5 acres	3.6 acres	1.3 miles	30-foot width for roadway and drainage
Off-site transmission line	91.6 acres	Included below	7.6 miles	50 feet each side of center
Tower structures	Included above	1.2 to 1.4 acres		85 to 100 towers x 1,024 SF per tower
Waterline and pumping station	8.0 acres	1 acre	3.4 miles	9.5 feet each side of center
Off-site electrical and communications overhead service	0.3 acre	Included below	539 feet	12 feet each side of center
Poles	Included above	26 SF		2 poles x 13 SF per pole
Subtotal	**104.4 acres**	**4.6 acres**		
On-Site Balance-of-Plant Development				
Construction staging and construction administration area east of Dunaway Road	25 acres	N/A		N/A
On-site construction laydown	11 acres	N/A		N/A
Site boundary fence line	29.9 acres	14.9 acres	20.5 miles	12-foot width construction access; 3 feet each side of the fence
Site paved roadways	137.6 acres	137.6 acres	25.2 miles	45-foot width for roadway and drainage
Unpaved perimeter roadways	16.2 acres	16.2 acres	11.2 miles	12 feet wide
Main Services Complex, parking and services	14.4 acres	14.4 acres		
Assembly buildings and storage	14 acres	N/A		
On-Site Wet and Dry Utilities Access				
Water pipeline	8.7 acres	N/A	3.8 miles	9.5 feet each side of center
On-site electrical and communications overhead service	3.8 acres	N/A	6,914 feet	12 feet each side of center
Solar Two Substation	7.7 acres	5.2 acres		650 feet by 350 feet
On-site transmission line	34.1 acres	N/A	2.8 miles	50 feet each side of center
Transmission access road	Included above	4.1 acres	2.8 miles	12 feet wide

Table 4: Estimated Disturbed Area Summary (Table Notes 1, 2)

Project Component Item	Area Construction Disturbance	Area Operations Permanent Disturbance	Proposed Length	Comments
Transmission tower structures	Included above	0.5 to 0.7 acre		35 to 40 towers at 1,024 SF per tower
34.5-kV overhead runs to Solar 2A Substation	4.0 acres	N/A		10.95 miles by 12-foot wide with a significant portion overlapping other construction disturbed areas (75 percent)
Poles	Included above	0.1 acre		
34.5-kV runs to overhead lines	5.2 acres	N/A		
Subtotal	**271.31 acres**	**173.73 acres**		
Solar Field Development = 500 by 1.5-MW Solar Groups (Table Notes 2,3)				
North-south access routes	245 acres	245 acres	168 miles	1,709 feet per 1.5 MW (0.47 acre-total) based on 12-foot wide road
East-west access routes	148.3 acres	148.3 acres	102 miles	1,033 feet per 1.5 MW (0.28 acre-total)
Electrical Collection System				
600 V underground	35 acres	N/A	576 miles	5,850 feet per 1.5 MW (0.52 acre-total) based on 2-foot each side of center
34.5-kV underground	20 acres	N/A	45 miles	460 feet per 1.5 MW (0.06 acre-total) based on 3-foot each side of center
SunCatcher Installation				
North-south access/ SunCatcher	440 acres	440 acres		1,600 feet per 1.5 MW (0.88 acre-total) based on 20-foot by 32-foot access/unit
East-west access/ SunCatcher	1,735 acres	1,735 acres		4,200 feet per 1.5 MW (3.47 acres-total) based on 36-foot by 70-foot access/unit
Subtotal	**2,623.4 acres**	**2,568.4 acres**		
TOTAL AREA	**3,000.1 acres**	**2,746.6 acres**		

Table Source: SES Solar Two, LLC, 2008.

Table General Note: During installation of the SunCatchers, only 50 percent of the total land would be disturbed. The modularity of the SunCatcher design and off-site manufacturing would enable a phased deployment, thereby

minimizing the proportion of the overall site that is disturbed at any give time during construction. The plan site layout minimizes traffic road operations of the Project.

Table Note 1: Refer to Figures 3-1 through 3-3 of the AFC for locations of Project components.

Table Note 2: Assumes 750-MW net development of 30,000 SunCatchers.

Table Note 3: Reference Figure 3-28, 1.5-MW Solar Two Construction Disturbance Plan.

Table Key: kV = kilovolt; MW = megawatt; N/A = not applicable; SF = square feet; V = volts.

Table 5: Vegetation Types Occurring within the Solar Two Project Boundary and Off-Site Transmission Line and Waterline

Vegetation Type	Project Boundary (acres)	Off-Site Transmission Line 100-foot buffer (acres)	Off-Site Waterline 10-foot buffer (acres)
Sonoran creosote bush scrub	6,423.3	997.4	254.1
Disturbed creosote bush scrub	4.4	0	92.2
Disturbed habitat	36.8	19.0	0.8
Developed	0.6	0.3	208.3
Totals	**6,465.1**	**93**	**10**

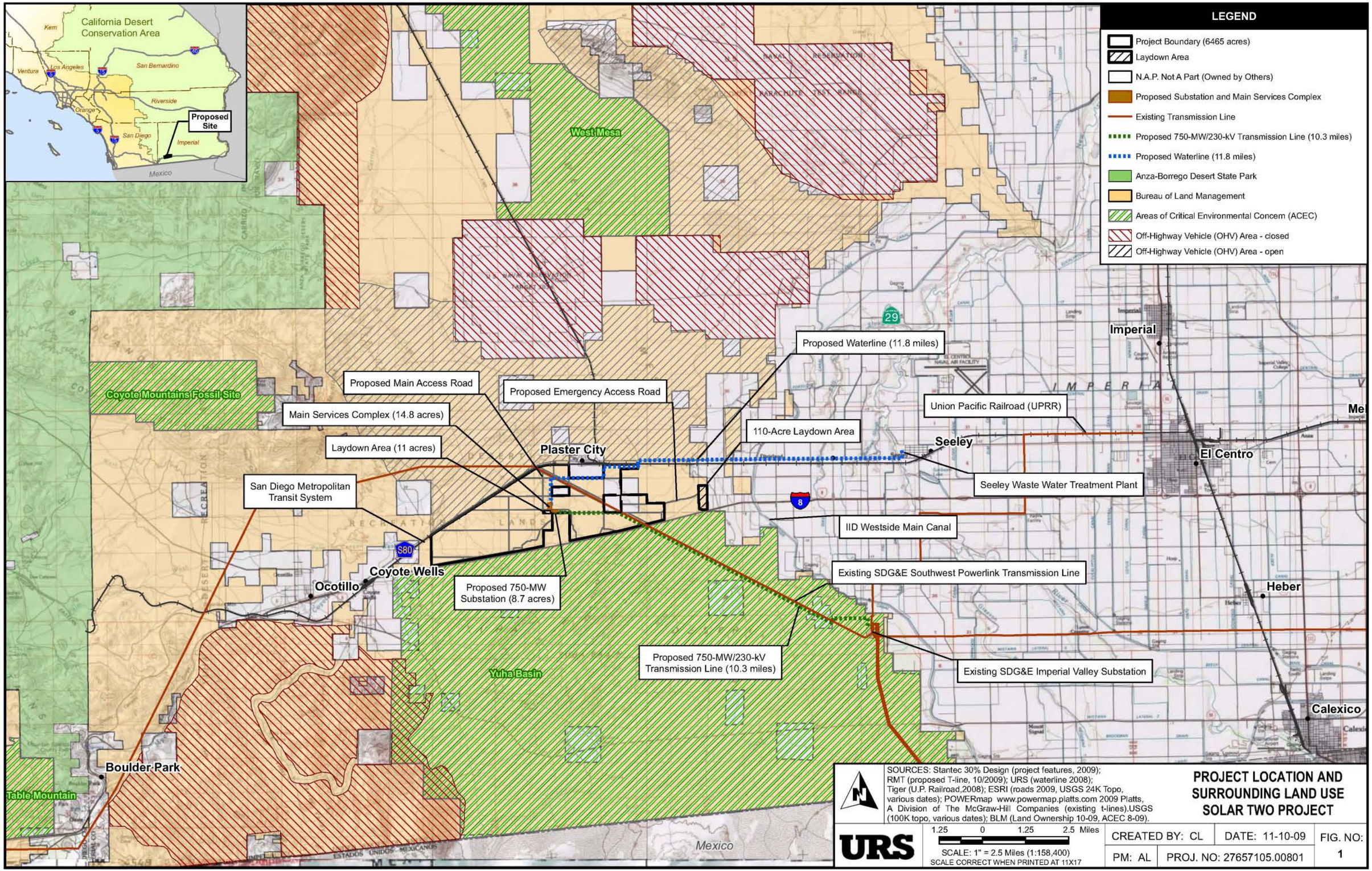
Table Source: URS Corporation, 2008.

Table 6: Overview of Acreage and Ownership of FTHL Management Areas (in acres)

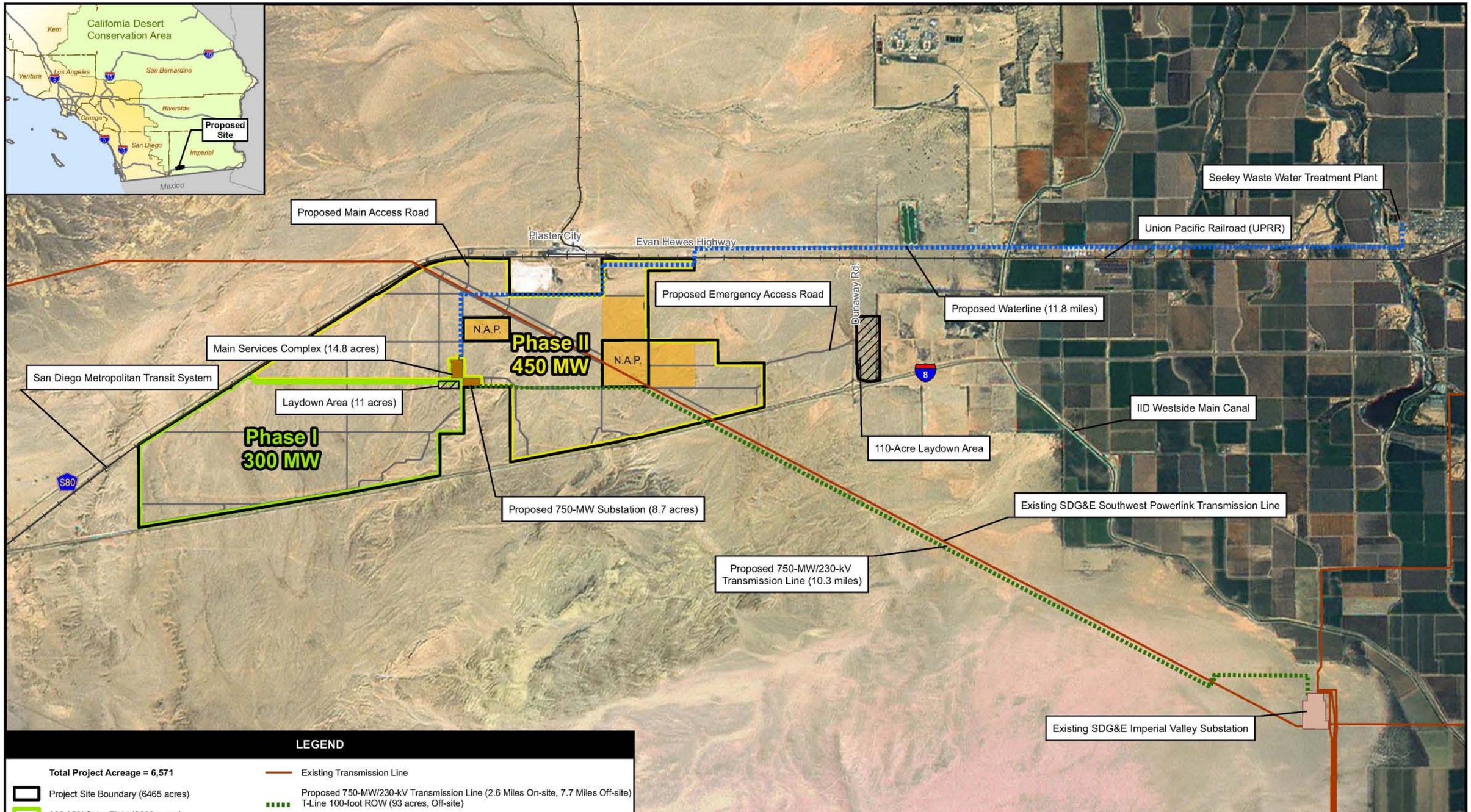
Management Area	Federal Non-military	Federal Military	State	Private	Total
Yuma Desert	16,200	114,800	0	0	131,000
East Mesa	99,900	8,500	0	6,900	115,300
West Mesa	83,200	29,800	1,300	21,800	136,100
Yuha Desert	57,200	0	0	3,000	60,200
Borrego Badlands	0	0	36,500	5,900	42,400
Total	**256,500**	**153,100**	**37,800**	**37,600**	**485,000**

Table Source: FTHL ICC, 2003

Section 9 Figures



Path: G:\gis\projects\1577\22238980\mxd\Biology\BA_Nov09\Surrounding_Landuse.mxd, 11/12/09, camille_lill



LEGEND

Total Project Acreage = 6,571

- Project Site Boundary (6465 acres)
- 300-MW Solar Field (2630 acres)
- 450-MW Solar Field (3725 acres)
- Laydown Area (110 acres)
- N.A.P. Not A Part (Owned by Others)
- Proposed Substation and Main Services Complex
- Existing SDG&E Imperial Valley Substation
- Existing Transmission Line
- Proposed 750-MW/230-kV Transmission Line (2.6 Miles On-site, 7.7 Miles Off-site) T-Line 100-foot ROW (93 acres, Off-site)
- Proposed Waterline (3.8 Miles On-site, 8 Miles Off-site) Waterline 10-foot ROW (10 acres Off-site)
- Union Pacific Railroad & San Diego Metropolitan Transit System
- Private Land Included in the Project (320 acres)

SOURCES: Following layers from Stantec 30% Design, Feb. 2009 (project boundary, N.A.P., laydown areas, existing SDGE substation, proposed 750-MW substation, main services complex, project roads, phase 1&2 boundaries). Aerial Imagery (NAIP, 2005). Proposed T-line (RMT, 10/2009). Waterline (URS, 2008). Private Land (BLM, 2008). U.P. Railroad (TIGER,2008). Roads (ESRI, 2009); POWERmap www.powermap.platts.com 2009 Platts, A Division of The McGraw-Hill Companies (existing t-lines).

PROJECT OVERVIEW MAP
SOLAR TWO PROJECT

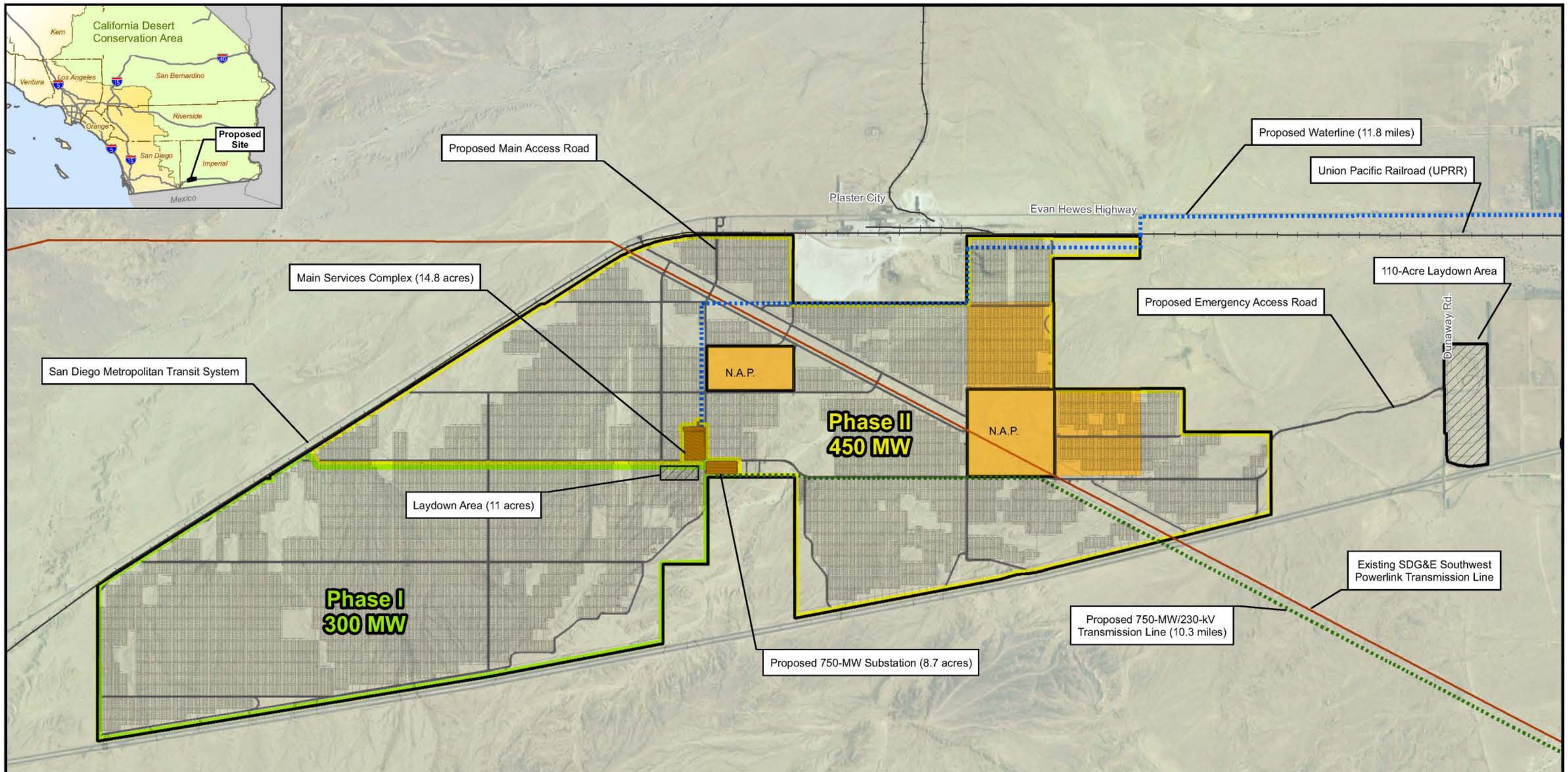
URS

0.5 0 0.5 1 Miles

SCALE: 1" = 1 Mile (1:63,360)
SCALE CORRECT WHEN PRINTED AT 11X17

CREATED BY: JS	DATE: 11-10-09	FIG. NO:
PM: AL	PROJ. NO: 27657105.00801	2

Path: G:\gis\projects\1577\22238980\mxd\Biology\BA_Nov09\Project_Overview_Map.mxd, 11/12/09, camille_lill



LEGEND

Total Project Acreage = 6,571

- Project Site Boundary (6465 acres)
- 300-MW Solar Field (2630 acres)
- 450-MW Solar Field (3725 acres)
- Laydown Area (110 acres)
- N.A.P. Not A Part (Owned by Others)
- Proposed Substation and Main Services Complex
- Existing SDG&E Imperial Valley Substation
- Existing Transmission Line
- Proposed 750-MW/230-kV Transmission Line (2.6 Miles On-site, 7.7 Miles Off-site) T-Line 100-foot ROW (93 acres, Off-site)
- Proposed Waterline (3.8 Miles On-site, 8 Miles Off-site) Waterline 10-foot ROW (10 acres Off-site)
- Union Pacific Railroad & San Diego Metropolitan Transit System
- Private Land Included in the Project (320 acres)

SOURCES: Following layers from Stantec 30% Design, Feb. 2009 (project boundary, N.A.P., laydown areas, existing SDGE substation, proposed 750-MW substation, main services complex, project roads, phase 1&2 boundaries); Aerial Imagery (NAIP, 2005). Proposed T-line (RMT, 10/2009). Waterline (URS, 2008). Private Land (BLM, 2008). U.P. Railroad (TIGER,2008). Roads (ESRI, 2009); POWERmap www.powermap.platts.com 2009 Platts, A Division of The McGraw-Hill Companies (existing t-lines).

FINAL SITE PLAN WITH ROADS SOLAR TWO PROJECT

URS

1500 0 1500 3000 Feet

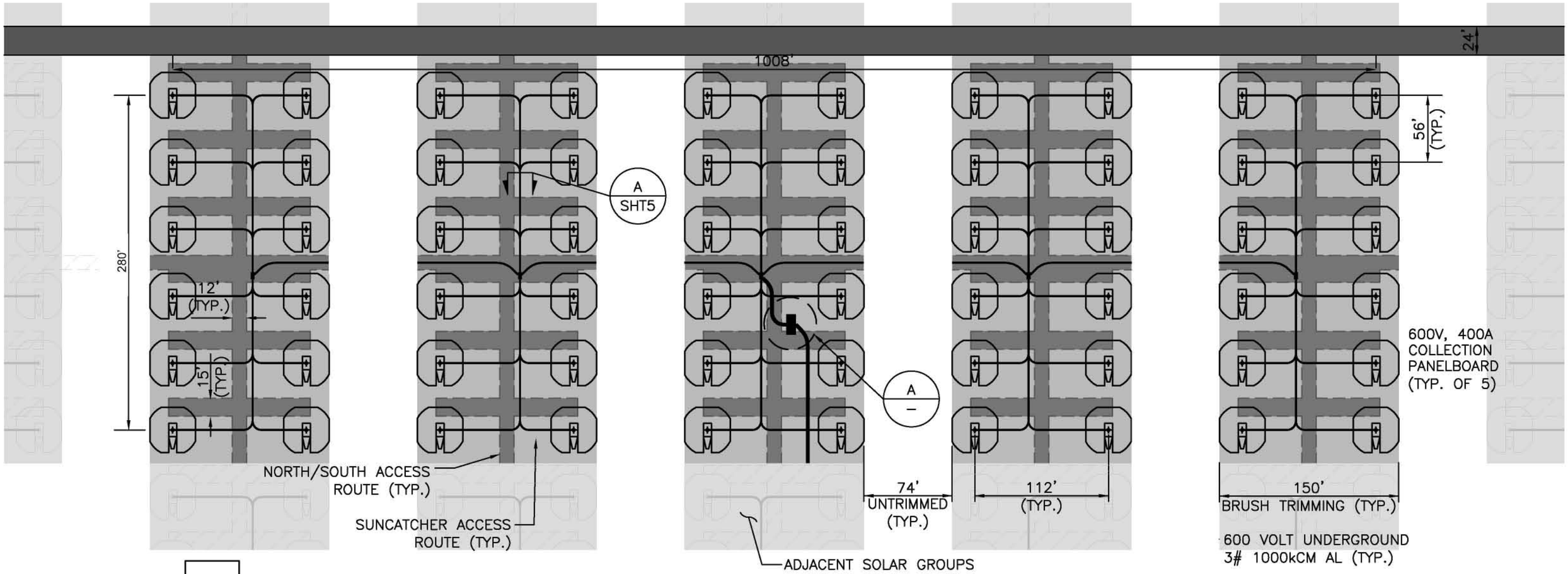
SCALE: 1" = 3000 Feet (1:36,000)
SCALE CORRECT WHEN PRINTED AT 11X17

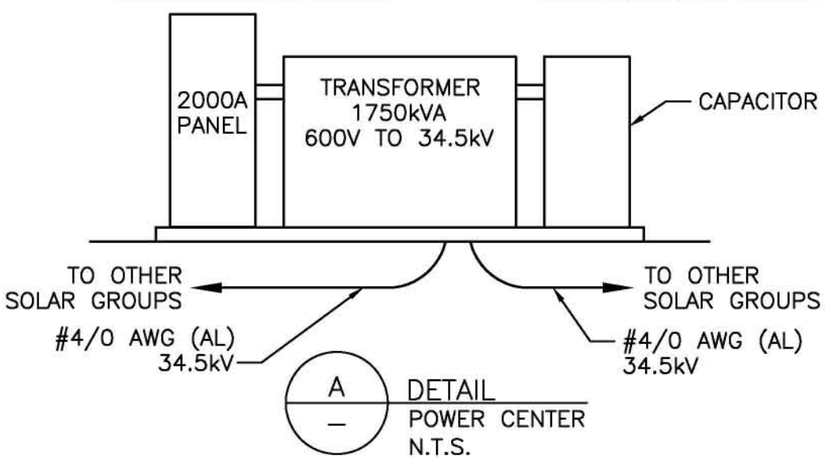
CREATED BY: CL	DATE: 11-10-09	FIG. NO:
PM: AL	PROJ. NO: 27657105.00801	3

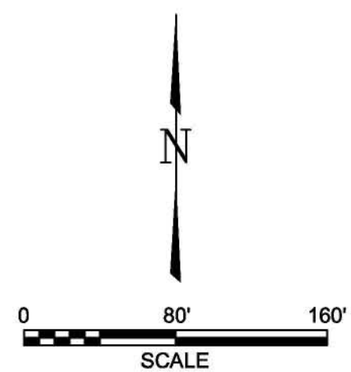
Path: G:\gis\projects\1577\22238980\mxd\Biology\BA_Nov09\SitePlan_withRoads.mxd, 11/12/09, camille_lill

URS	COLOR PHOTOGRAPHIC SIMULATION CLOSE-UP OF THE SITE AFTER CONSTRUCTION SOLAR TWO PROJECT		
	CREATED BY: JW	DATE: 11-10-09	FIG. NO: 4
	PM: AL	PROJ. NO: 27657105.00801	

Path: G:\gis\projects\1577\22238980\mxd\Biology\BA_Nov09\Visual_Simulation.mxd, 11/12/09, camille_lill







LEGEND

- BRUSH TRIMMING
- PAVED ROADWAYS
- UNPAVED ACCESS ROUTE
- SUNCATCHER UNIT

NOTES

1. THIS IS A REPRESENTATION (BUT NOT NECESSARILY TYPICAL) OF A 1.5MW SOLAR GROUP. THE 1.5MW SOLAR GROUPS WILL BE ARRANGED TO FIT THE CONTOURS OF THE SITE.
2. ONE 1.5MW SOLAR GROUP IS COMPRISED OF SIXTY (60) SUNCATCHER UNITS CONNECTED INTO FIVE (5) TWELVE–UNIT GROUPS CONNECTED TO A 600V, 400A COLLECTION PANELBOARD.

PRELIMINARY

NO.	DATE		BY	APP.
P1	04/23/07	ISSUED FOR PRELIMINARY REVIEW	PH	
P2	07/25/07	'CLEARING' REFERENCES CHANGES TO 'TRIMMING'	PH	
P3	02/27/08	RELOCATED ACCESS ROUTE	PH	
P4	04/16/08	REVISED CABLE TYPE	PH	

STANTEC CONSULTING INC.
9400 S.W. BARNES ROAD
STE. 200
PORTLAND, OREGON, 97225
503.297.1631
STANTEC.COM

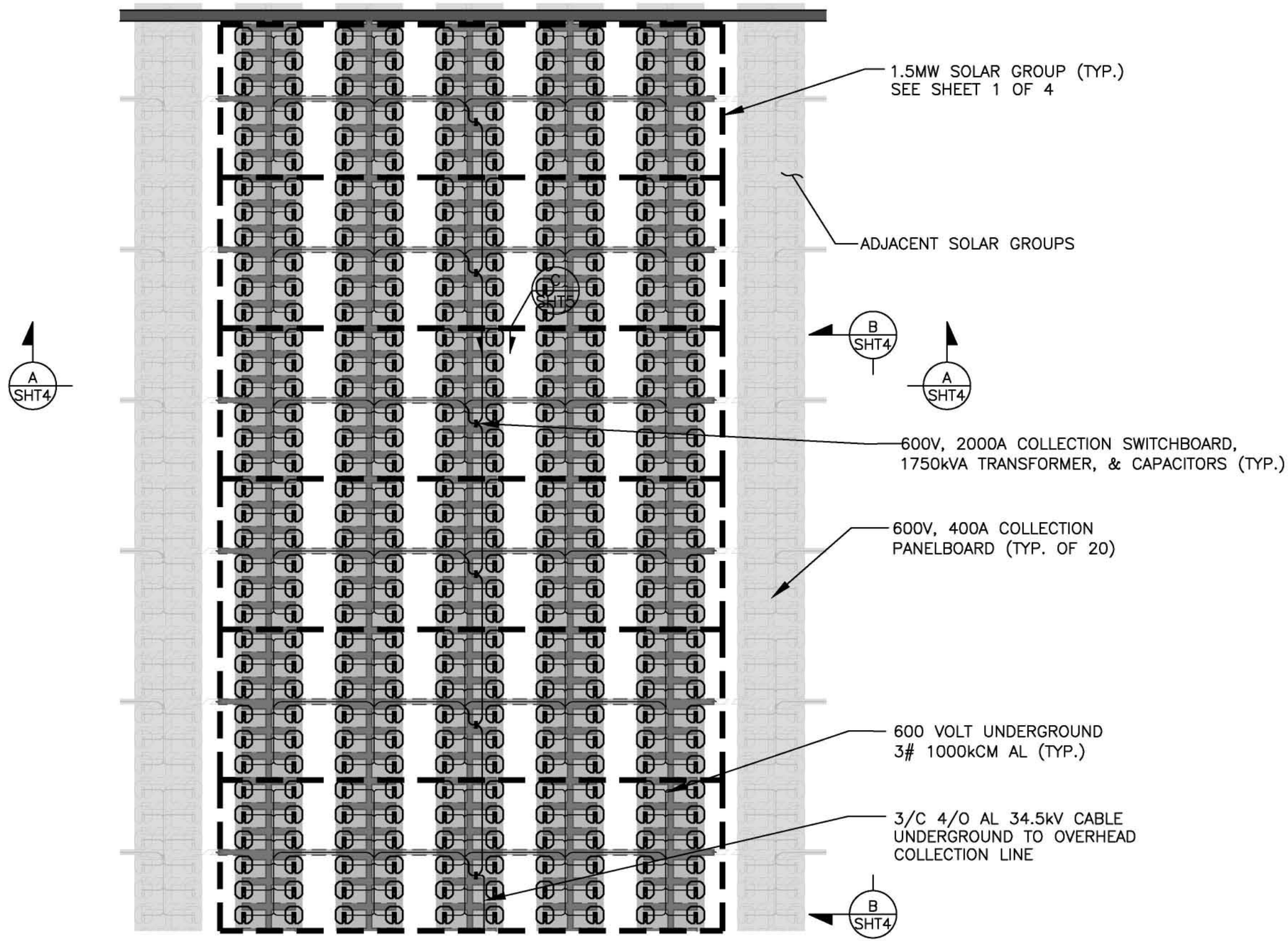
DRN. STC/GSP	DES. STC/PH	CHK. STC/	DATE 03/07/07
SCALE 1"=80'–0"		APP.	DATE

SOLAR TWO 1.5-MW
SOLAR GROUP PLAN
SOLAR TWO PROJECT

URS

CREATED BY: STANTEC	DATE: 11-9-09	FIG. NO:
PM: AL	PROJ. NO: 27657105.00801	5A

P:\Sys4\2000026801-Solar2\Exhibits\S2-G-0002-01.dwg, 4/16/2008 1:47:03 PM, slee



LEGEND

- BRUSH TRIMMING
- PAVED ROADWAYS
- UNPAVED ACCESS ROUTE
- SUNCATCHER UNIT

NOTES

1. THIS IS A REPRESENTATION (BUT NOT NECESSARILY TYPICAL) OF AN 9MW SOLAR GROUP. THE 9MW SOLAR GROUPS WILL BE ARRANGED TO FIT THE CONTOURS OF THE SITE.
2. THE SIX (6) 1.5MW SOLAR GROUPS ARE CONNECTED IN SERIES TO THE RISER TO THE OVERHEAD 34.5kV COLLECTION LINE BY 34.5kV UNDERGROUND CABLES

N

0 160' 320'
SCALE

PRELIMINARY

NO.	DATE		BY	APP.
P1	04/23/07	ISSUED FOR PRELIMINARY REVIEW	PH	
P2	07/25/07	'CLEARING' REFERENCES CHANGES TO 'TRIMMING'	PH	
P3	02/27/08	RELOCATED ACCESS ROUTE	PH	
P4	04/16/08	REVISED 9MW	PH	

STANTEC CONSULTING INC.
9400 S.W. BARNES ROAD
STE. 200
PORTLAND, OREGON, 97225
503.297.1631
STANTEC.COM

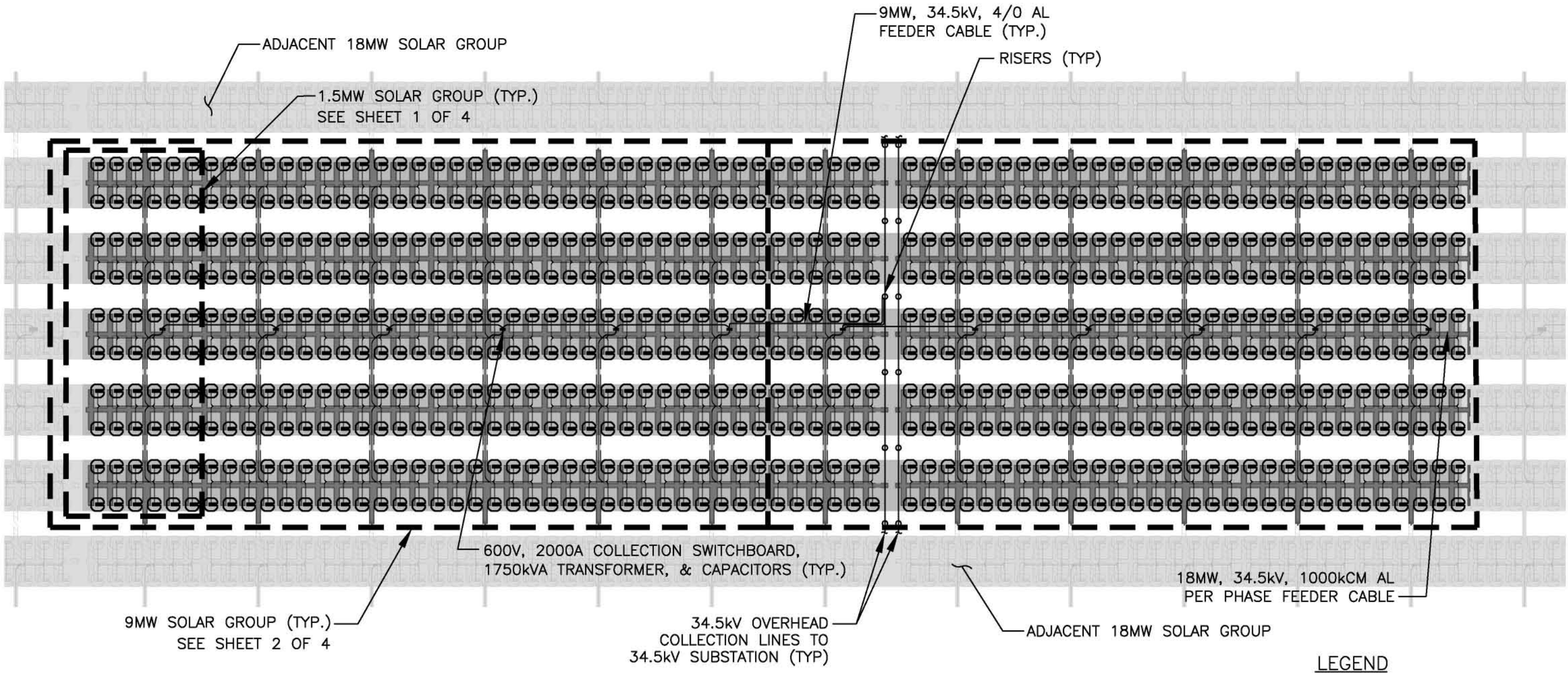
DRN. STC/GSP	DES. STC/PH	CHK. STC/	DATE 03/07/07
SCALE 1"=160'-0"		APP.	DATE

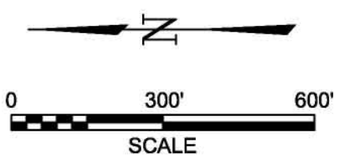
SOLAR TWO 9-MW
SOLAR GROUP PLAN
SOLAR TWO PROJECT

URS

CREATED BY: STANTEC	DATE: 11-9-09	FIG. NO:
PM: AL	PROJ. NO: 27657105.00801	5B

P:\Sys4\2000026801-Solar2\Exhibits\S2-G-0002-02.dwg, 4/16/2008 1:39:30 PM, slee





NOTE

THIS IS A REPRESENTATION (BUT NOT NECESSARILY TYPICAL) OF AN 18MW SOLAR GROUP. THE 18MW SOLAR GROUPS WILL BE ARRANGED TO FIT THE CONTOURS OF THE SITE.

LEGEND

- BRUSH TRIMMING
- PAVED ROADWAYS
- UNPAVED ACCESS ROUTE
- SUNCATCHER UNIT

PRELIMINARY

NO.	DATE		BY	APP.
P1	04/23/07	ISSUED FOR PRELIMINARY REVIEW	PH	
P2	07/25/07	'CLEARING' REFERENCES CHANGES TO 'TRIMMING'	PH	
P3	02/27/08	RELOCATED ACCESS ROUTE	PH	
P4	04/16/08	REV. CABLE TYPE; 9MW GROUPS & OH COLL.	PH	

STANTEC CONSULTING INC.
9400 S.W. BARNES ROAD
STE. 200
PORTLAND, OREGON, 97225
503.297.1631
STANTEC.COM

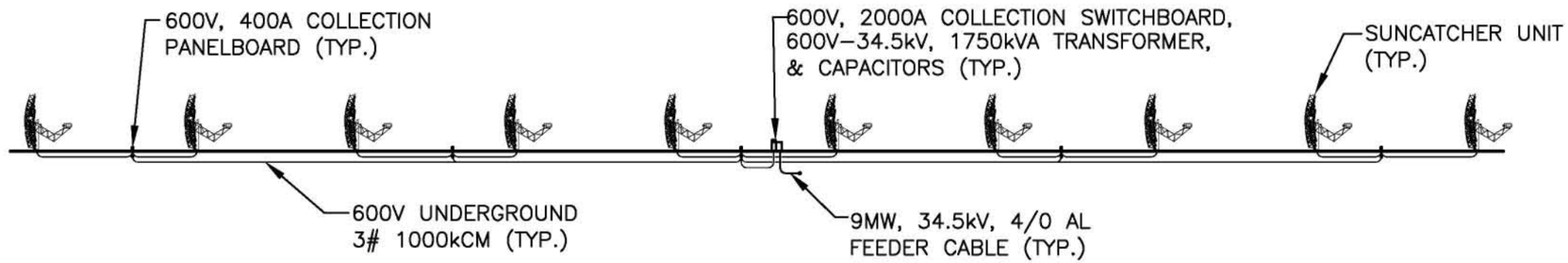
DRN. STC/GSP	DES. STC/PH	CHK. STC/	DATE 03/07/07
SCALE 1"=300'-0"		APP.	DATE

SOLAR TWO 18-MW
SOLAR GROUP PLAN
SOLAR TWO PROJECT

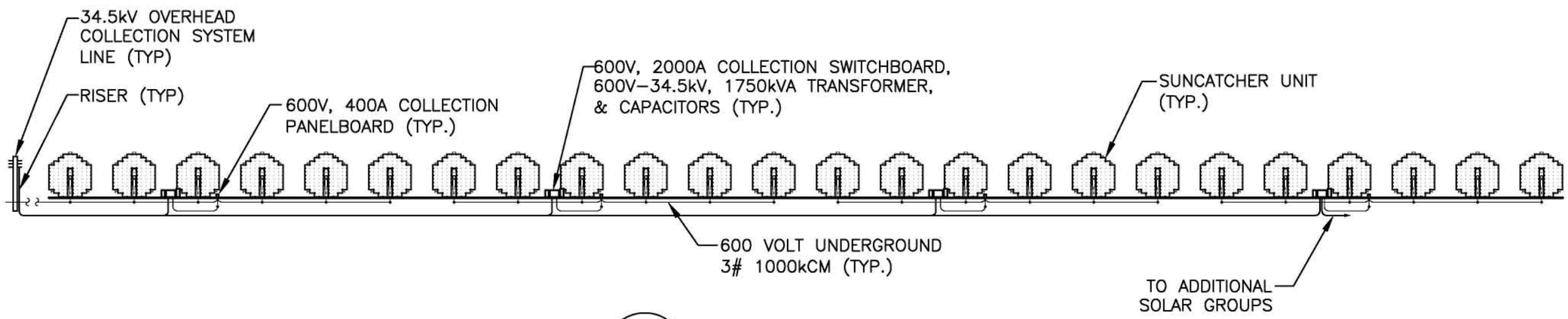
URS

CREATED BY: STANTEC	DATE: 11-9-09	FIG. NO:
PM: AL	PROJ. NO: 27657105.00801	5C

P:\Sys4\2000026801-Solar2\Exhibits\S2-G-0002-03.dwg, 4/16/2008 1:49:20 PM, slee



AA / – SECTION (LOOKING NORTH)
(SUNCATCHER UNITS FACING EAST)
SCALE: 1"=100'



BB / – SECTION (LOOKING WEST)
(SUNCATCHER UNITS FACING EAST)
SCALE: 1"=100'

PRELIMINARY

NO.	DATE		BY	APP.
P1	04/23/07	ISSUED FOR PRELIMINARY REVIEW	PH	
P2	04/16/08	REV. CABLE TYPE & OH COLL.	PH	

STANTEC CONSULTING INC.
9400 S.W. BARNES ROAD
STE. 200
PORTLAND, OREGON, 97225
503.297.1631
STANTEC.COM

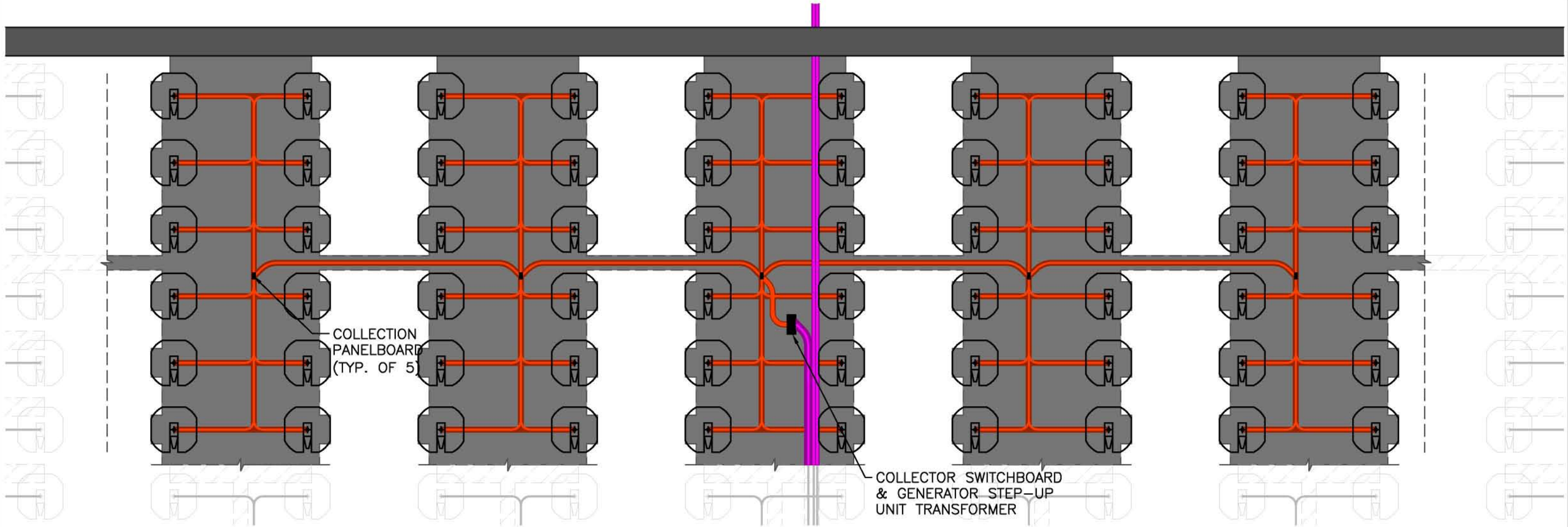
DRN. STC/GSP	DES. STC/PH	CHK. STC/	DATE 03/07/07
SCALE AS SHOWN		APP.	DATE

SOLAR TWO
TYPICAL ELEVATION VIEW
SOLAR TWO PROJECT

URS

CREATED BY: STANTEC	DATE: 11-9-09	FIG. NO:
PM: AL	PROJ. NO: 27657105.00801	5D

P:\Sys4\2000026801-Solar2\Exhibits\S2-G-0002-04.dwg, 4/16/2008 1:50:11 PM, slee



N

0 80' 160'
SCALE

LEGEND

- UNPAVED ACCESS ROUTE
- PAVED ROADWAYS
- SUNCATCHER UNIT
- 600V COLLECTOR CABLE WITH 4' BUFFER
- 34.5kV CABLE WITH 12' BUFFER

NOTES

1. THIS IS A REPRESENTATION OF A 1.5MW SOLAR GROUP. THE 1.5MW SOLAR GROUPS WILL BE ARRANGED TO FIT THE CONTOURS OF THE SITE.
2. ONE 1.5MW SOLAR GROUP IS COMPRISED OF SIXTY (60) SUNCATCHER UNITS CONNECTED INTO FIVE (5) TWELVE-UNIT GROUPS CONNECTED TO A 600V, 400A COLLECTION PANELBOARD.

PRELIMINARY

NO.	DATE		BY	APP.
P1	07/30/07	ISSUED FOR PRELIMINARY REVIEW	PH	
P2	02/27/08	RELOCATED ACCESS ROUTE	PH	
P3	04/16/08	RELOCATED ACCESS ROUTE	PH	

STANTEC CONSULTING INC.
9400 S.W. BARNES ROAD
STE. 200
PORTLAND, OREGON, 97225
503.297.1631
STANTEC.COM

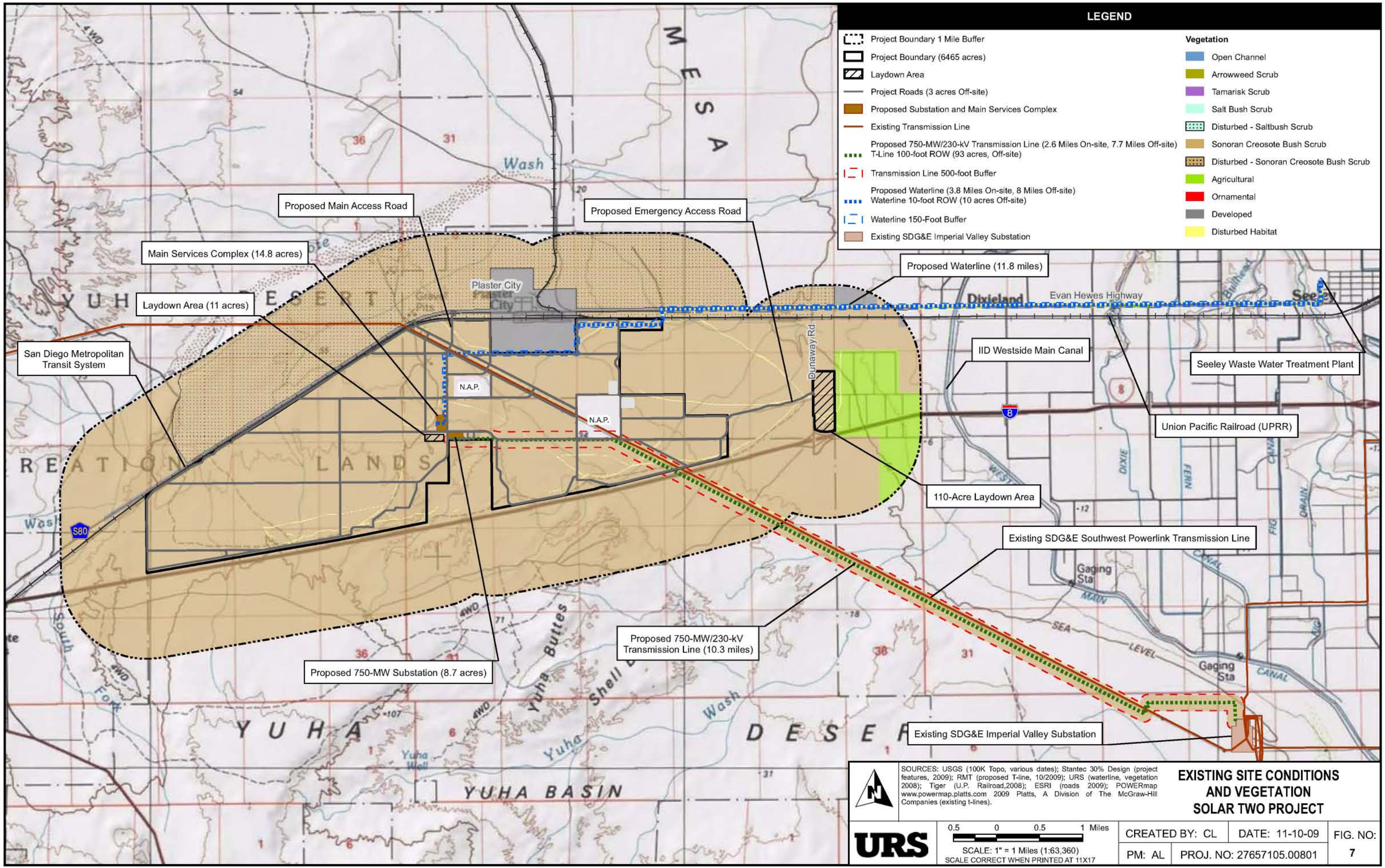
DRN. STC/GSP	DES. STC/PH	CHK. STC/	DATE 07/30/07
SCALE 1"=80'-0"		APP.	DATE

1.5-MW SOLAR TWO CONSTRUCTION DISTURBANCE PLAN SOLAR TWO PROJECT

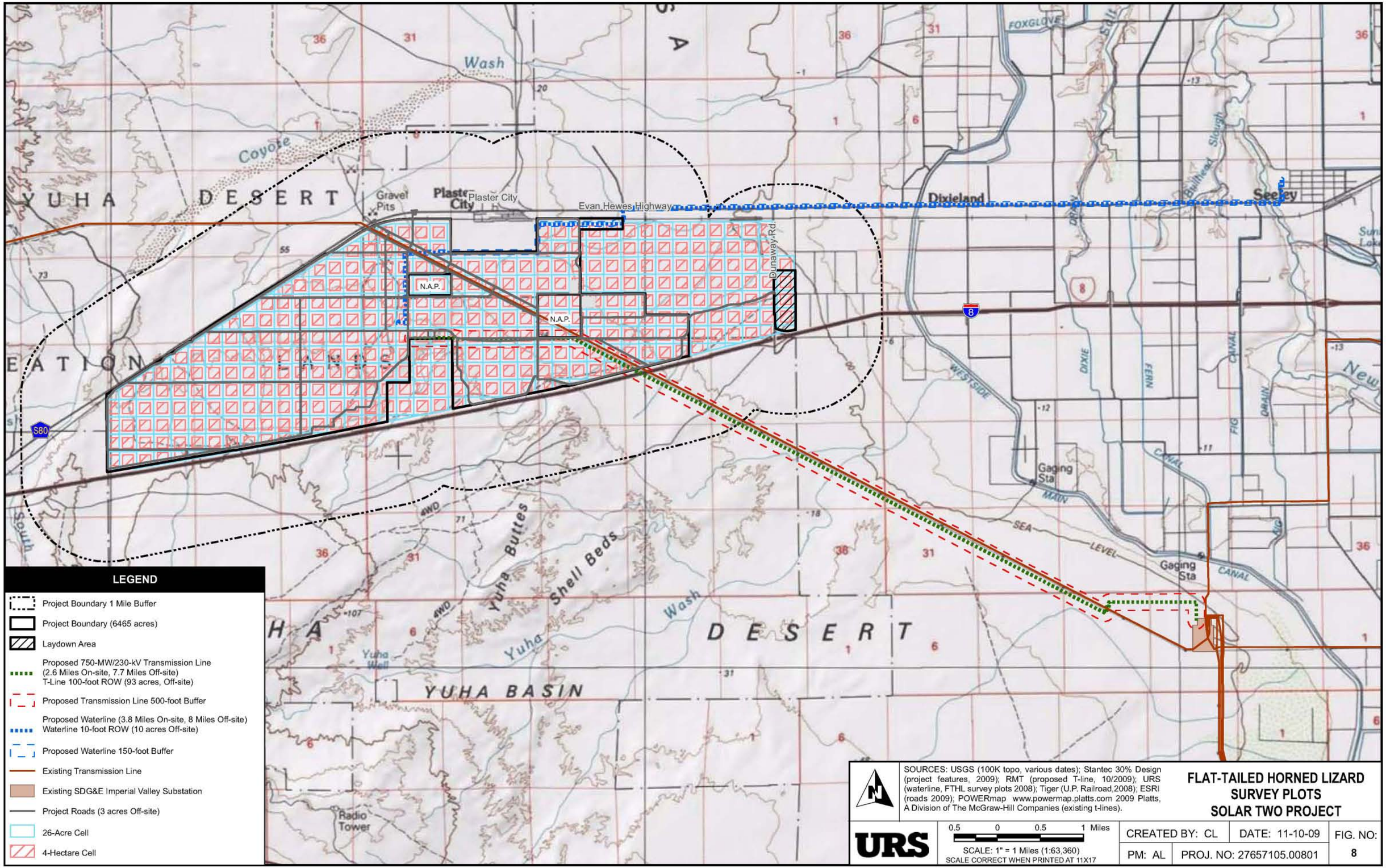
URS

CREATED BY: STANTEC	DATE: 11-9-09	FIG. NO: 6
PM: AL	PROJ. NO: 27657105.00801	

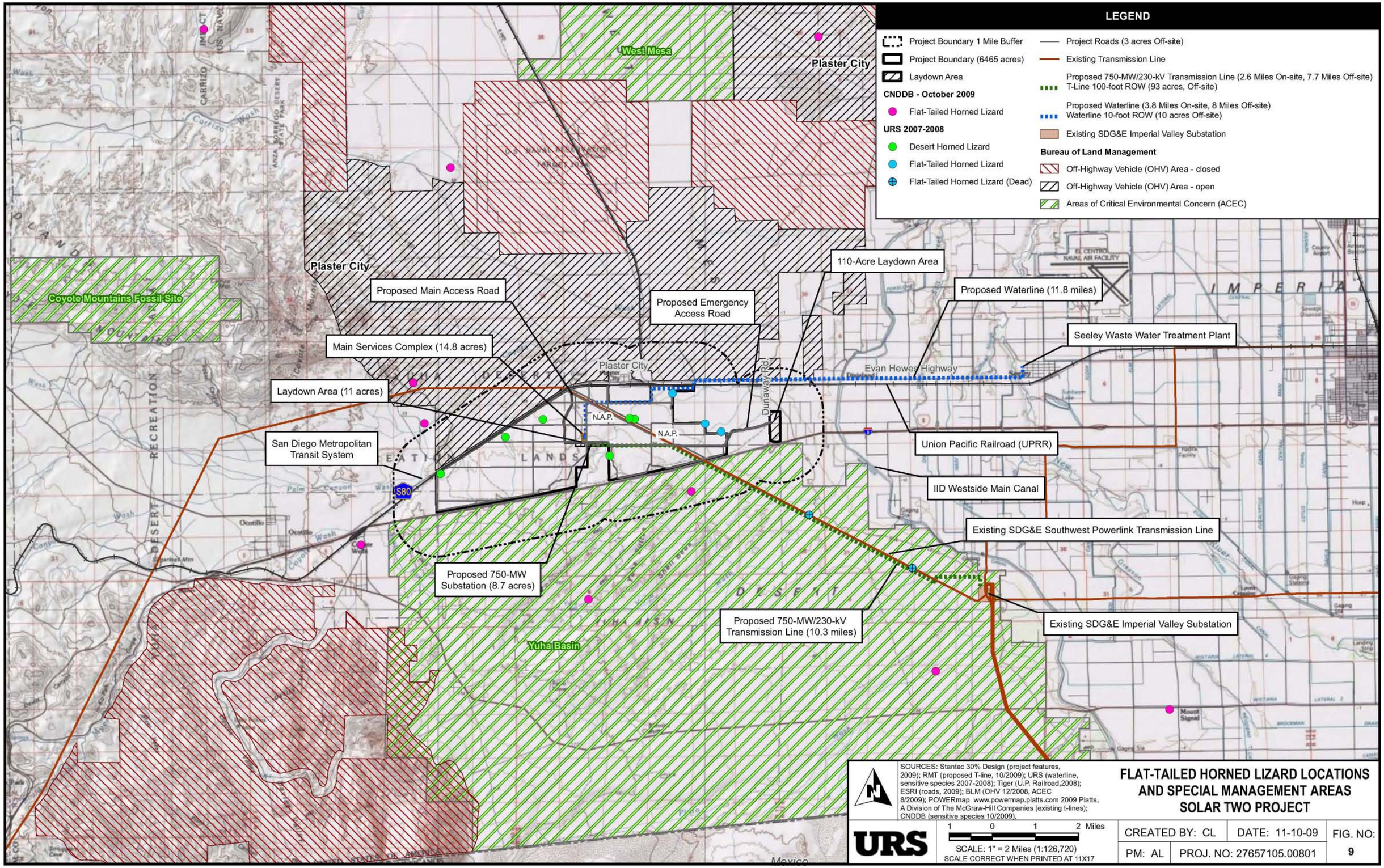
P:\Sys4\2000026801-Solar2\Exhibits\52-G-0005-01.dwg, 4/16/2008 11:48:17 AM, slee



Path: G:\gis\projects\1577\22238980\mxd\Biology\BA_Nov09\siteconditions_vegetation.mxd, 11/12/09, camille_lill



Path: G:\gis\projects\1577\22238980\mxd\Biology\BA_Nov09\FTHL_SurveyPlots.mxd, 11/12/09, camille_lill



SOURCES: Stantec 30% Design (project features, 2009); RMT (proposed T-line, 10/2009); URS (waterline, sensitive species 2007-2008); Tiger (U.P. Railroad,2008); ESRI (roads, 2009); BLM (OHV 12/2008, ACEC 8/2009); POWERmap www.powermap.platts.com 2009 Platts, A Division of The McGraw-Hill Companies (existing t-lines); CNDDB (sensitive species 10/2009).

FLAT-TAILED HORNED LIZARD LOCATIONS AND SPECIAL MANAGEMENT AREAS SOLAR TWO PROJECT

URS

1 0 1 2 Miles

SCALE: 1" = 2 Miles (1:126,720)
SCALE CORRECT WHEN PRINTED AT 11X17

CREATED BY: CL	DATE: 11-10-09	FIG. NO:
PM: AL	PROJ. NO: 27657105.00801	9

Path: G:\gis\projects\1577\22238980\mxd\Biology\BA_Nov09\FTHL_locsandmgmtareas.mxd, 11/12/09, camille_lill

Appendix A

Flat-Tailed Horned Lizard Population Estimates for the West Mesa, East Mesa, Yuma, and Yuha Basin Management Areas, 2007–2009

Flat-Tailed Horned Lizard Population Estimates for the West Mesa, East Mesa, Yuma, and Yuha Basin Management Areas, 2007-2009

Final Report
Submitted to URS Corporation,
in fulfillment of URS Project No. 27657105

9 November 2009

Prepared by:

William B. Kristan III, Ph.D.
Department of Biological Sciences
California State University, San Marcos
San Marcos, CA 92096

1.0 Introduction and Methods

Population abundances of flat-tailed horned lizards (Phrynosoma mcallii) were estimated for plots at five different study areas, West Mesa Management Area (plots WM1 and WM2), East Mesa Management Area (plot EM1), Yuma AZ (plot YM1 and YM2), and the Yuha Basin Management area (plot YU1). Data were obtained from the Bureau of Land Management, El Centro Field Office, for 2007, 2008, and 2009 as part of their ongoing monitoring. BLM used a consistent survey methodology for each plot, in which two teams searched a plot for 9-11 consecutive days. Plots were 9 ha in size. Horned lizards were sexed and marked with PIT tags, so that individual capture histories could be obtained, and the data set analyzed comprised the 592 captures of 318 marked individuals across all six plots. Summary statistics for data from each site are listed in Table 1.

Table 1. Days sampled and unique individuals marked on each plot and year.

Plot	2007 Days Sampled	2008 Days Sampled	2009 Days Sampled	2007 Unique Individuals	2008 Unique Individuals	2009 Unique Individuals
EM1	10	10	10	31	18	40
WM1	10	10	9	12	5	13
WM2		10	9		39	39
YM1		10			14	
YM2		11			33	
YU1	10	10	10	24	17	33

Capture histories were used in the MARK population estimation software package (program MARK, version 5.1 build 2600, White and Burnham 1999) to obtain estimates of abundance, using Huggins closed capture models. These models were used by Grant as part of his MS thesis work on several of these same populations, done between 2002 and 2004, and proved effective at producing precise abundance estimates in spite of the small numbers of captures and low recapture probabilities he found (Grant 2005).

Because plots were surveyed for different numbers of days in some years, it was not possible to conduct an analysis that included all of the data at once. Consequently, I conducted two different sets of analyses: the first included all sites, but only used the first nine days of sampling, with the tenth and eleventh days omitted from sites with more than nine days captures, and the second was done with all days of captures, but split by site (and by plot for WM1 and WM2, to isolate the 2009 samples that only had nine capture days for each plot).

1.1 Nine-Day Dataset

The sizes of standard errors in population estimates are affected by the number of capture histories used. Additionally, the greatest power to detect heterogeneity in capture and recapture probabilities from various sources (e.g. behavioral responses, variation over the course of sampling, between sexes) would be obtained from analyzing the entire data set. However, because MARK requires all capture histories to be the same length, for this first analysis only the first nine days of every capture history was used. This resulted in capture histories for animals first captured in the tenth or eleventh day being dropped from the analysis, such that this analysis used 304 of the 318 capture histories.

With this largest available data set, I evaluated whether capture probabilities differed by (a) sampling day (which would be expected if animals were either more or less likely to be recaptured after their first capture experience), (b) first capture vs. recapture, (b) plot, (c) sex, or (d) year. A null model with constant probability of capture was fitted as well. The best-supported model from this set was used to generate abundance estimates and confidence intervals, with the expectation that precision would be good, but because some capture histories were omitted the estimates might not be as accurate as the plot-specific analyses described below.

1.2 Plot-Specific Datasets

I conducted a second set of analyses for each plot, using all of the capture days, and thus all of the 318 capture histories available. For WM1 and WM2, data were split into two sets to reflect the different numbers of days sampled. I used 2007 and 2008 together for WM1, separately analyzed 2009 for WM1, and split 2008 from 2009 for WM2. Estimates of population size were obtained for these data sets, using only the best-supported model of capture probabilities identified with the full nine-day dataset.

1.3 Density Estimates

Once population size estimates were obtained from MARK, I calculated density estimates by dividing population size by plot area. The standard error of density was calculated using the Delta Method (Powell 2007), and confidence intervals were calculated as normal approximations (D ± 1.96 S.E.).

2.0 Results

2.1 Capture Probabilities and Abundance Estimates

2.1.1 Nine-Day Dataset

The null model, of a constant capture probability across days, plots, years, and sexes, was best supported. The next best supported model used a different probability of first capture and recapture, each of which were constant across days, plots, years, and sexes (ΔAIC = 1.25). All other models received essentially no support, with ΔAIC values that were at least 14 units (values of ΔAIC greater than 4 are considered poorly supported, Burnham and Anderson 1998). The capture probability estimated from the null model was 0.15 (95% CI = 0.14-0.17). Estimates of population sizes for each plot and year combination were obtained from the null model, and based on these results, the plot-specific analyses all used a constant capture probability as well (although this probability was estimated separately for each). Estimates of population size on each plot and year, based on the nine-day data set, are given in Table 2.

Table 2. Estimates of population sizes based on the null model of the nine-day data set.

Site	Year	N-hat	SE	95% CI, Lower	95% CI, Upper
EM1	2007	38.85	3.53	34.17	48.81
EM1	2008	22.04	2.62	18.93	30.14
EM1	2009	47.96	3.97	42.51	58.82
WM1	2007	15.56	2.18	13.17	22.78
WM1	2008	6.48	1.40	5.31	12.07
WM1	2009	16.85	2.28	14.32	24.27
WM2	2008	46.67	3.91	41.32	57.40
WM2	2009	50.56	4.09	44.90	61.65
YM1	2008	16.85	2.28	14.32	24.27
YM2	2008	41.48	3.67	36.56	51.72
YU1	2007	29.82	3.07	25.93	38.83
YU1	2008	19.45	2.45	16.62	27.21
YU1	2009	41.48	3.67	36.56	51.72

2.1.2 Plot-Specific Datasets

Based on the results of the larger nine-day dataset, all estimates for each plot were done with null models, using only a single capture probability for each plot. The capture probability was estimated for each data set, and is given in Table 3. All of the capture probabilities were between 0.13 and 0.19, and all of the confidence intervals overlapped. All of the confidence intervals also contained the capture probability estimated from the nine-day dataset.

Table 3. Capture Probabilities estimated for each plot-specific data set.

Data Set	P	SE	Lower	Upper
EM1, all years	0.14	0.01	0.11	0.17
WM1, 2007-2008	0.14	0.03	0.08	0.21
WM1, 2009	0.13	0.04	0.07	0.22
WM2, 2008	0.19	0.02	0.15	0.24
WM2, 2009	0.15	0.02	0.11	0.20
YM1	0.13	0.03	0.07	0.21
YM2	0.14	0.02	0.10	0.18
YU1	0.16	0.02	0.13	0.19

Population size estimates based on these capture probabilities are reported in Table 4.

Table 4. Population size estimates based on plot-specific datasets.

Site	Year	N-hat	SE	95% CI, Lower	95% CI, Upper
EM1	2007	40.03	3.90	35.01	51.32
EM1	2008	23.27	2.83	19.96	32.14
EM1	2009	51.71	4.59	45.58	64.58
WM1	2007	15.67	2.81	12.97	25.88
WM1	2008	6.54	1.60	5.29	13.22
WM1	2009	18.49	4.16	14.47	33.57
WM2	2008	44.24	2.95	40.87	53.67
WM2	2009	50.44	5.30	43.82	66.14
YM1	2008	18.79	3.59	15.30	31.74
YM2	2008	41.13	4.22	36.12	54.16
YU1	2007	29.30	2.82	25.99	38.09
YU1	2008	20.77	2.31	18.25	28.41
YU1	2009	40.32	3.42	36.06	50.51

For ease of comparison, the estimated abundances for each method along with the number of marked individuals are presented in Table 5. The two sets of estimates are largely in agreement, and are highly correlated with one another (r = 0.99).

Table 5. Numbers of individual horned lizards marked, and population estimates using nine-day and plot-specific data sets.

Site	Year	Marked Individuals	Plot-Specific	Nine-Day
EM1	2007	31	40.03	38.85
EM1	2008	18	23.27	22.04
EM1	2009	40	51.71	47.96
WM1	2007	12	15.67	15.56
WM1	2008	5	6.54	6.48
WM1	2009	13	18.49	16.85
WM2	2008	39	44.24	46.67
WM2	2009	39	50.44	50.56
YM1	2008	14	18.79	16.85
YM2	2008	33	41.13	41.48
YU1	2007	24	29.3	29.82
YU1	2008	17	20.77	19.45
YU1	2009	33	40.32	41.48

2.2 Density Estimates

Abundances were converted to density estimates (D) by dividing by the abundance estimates by the area of the plot in hectares (9 ha). Variance in density was estimated as variance in the estimates (SE2) divided by area squared (Powell 2007). Confidence intervals are normal approximations (1.96 SE). Density estimates are in Table 6. Mean density for all plot-years was 3.43 lizards per ha.

Previous work on flat-tailed horned lizards in this area adjusted for the large home ranges of the animals by estimating the probability of finding them on the plot when sampling was done (Grant 2005). Grant found horned lizards on the plots 60% of the time, and used this estimate to adjust his density estimates, by multiplying the estimate by 0.6. For ease of comparison with Grant's findings, the adjusted estimates are provided in Table 7. Adjusted mean density for all plot-years was 2.06 lizards per ha.

Table 6. Density estimates using nine-day and plot-specific datasets.

Site	Year	D	SE	Lower	Upper
Nine-Day Dataset					
EM1	2007	4.32	0.39	3.55	5.09
EM1	2008	2.45	0.29	1.88	3.02
EM1	2009	5.33	0.44	4.46	6.19
WM1	2007	1.73	0.24	1.25	2.20
WM1	2008	0.72	0.16	0.42	1.02
WM1	2009	1.87	0.25	1.38	2.37
WM2	2008	5.19	0.43	4.33	6.04
WM2	2009	5.62	0.45	4.73	6.51
YM1	2008	1.87	0.25	1.38	2.37
YM2	2008	4.61	0.41	3.81	5.41
YU1	2007	3.31	0.34	2.64	3.98
YU1	2008	2.16	0.27	1.63	2.69
YU1	2009	4.61	0.41	3.81	5.41
Plot-Specific Dataset					
EM1	2007	4.45	0.43	3.60	5.30
EM1	2008	2.59	0.31	1.97	3.20
EM1	2009	5.75	0.51	4.75	6.75
WM1	2007	1.74	0.31	1.13	2.35
WM1	2008	0.73	0.18	0.38	1.08
WM1	2009	2.05	0.46	1.15	2.96
WM2	2008	4.92	0.33	4.27	5.56
WM2	2009	5.60	0.59	4.45	6.76
YM1	2008	2.09	0.40	1.31	2.87
YM2	2008	4.57	0.47	3.65	5.49
YU1	2007	3.26	0.31	2.64	3.87
YU1	2008	2.31	0.26	1.80	2.81
YU1	2009	4.48	0.38	3.74	5.22

Table 7. Density estimates (D) adjusted for 60% probability that izards are on the plot during surveys, as reported by Grant (2005).

Site	Year	Nine-day D	Nine-Day D adj.	Plot-Specific D	Plot-Specific D adj.
EM1	2007	4.32	2.59	4.45	2.67
EM1	2008	2.45	1.47	2.59	1.55
EM1	2009	5.33	3.20	5.75	3.45
WM1	2007	1.73	1.04	1.74	1.04
WM1	2008	0.72	0.43	0.73	0.44
WM1	2009	1.87	1.12	2.05	1.23
WM2	2008	5.19	3.11	4.92	2.95
WM2	2009	5.62	3.37	5.60	3.36
YM1	2008	1.87	1.12	2.09	1.25
YM2	2008	4.61	2.77	4.57	2.74
YU1	2007	3.31	1.99	3.26	1.96
YU1	2008	2.16	1.30	2.31	1.39
YU1	2009	4.61	2.77	4.48	2.69

3.0 Conclusions

Given that both methods of handling the data (nine-day and plot-specific estimates) yielded density estimates that were very similar, the plot-specific numbers should be preferred. Even though the confidence interval sizes are slightly larger when the plot-specific analysis is done, using only nine days for plots with ten or eleven days of sampling led to animals being omitted, and thus the plot-specific estimates are likely to be more accurate.

For ease of comparison with Grant's density estimates (Grant 2005), the adjusted densities in Table 7 are based on the same probability of presence on the plots that Grant used ($p = 0.6$). However, this set of data is based on a larger plot size (9 ha rather than Grant's 4 ha), which increases the chance that horned lizard home ranges will fall entirely within the plot. Consequently, to apply this adjustment properly it would be necessary to estimate the probability of finding horned lizards on 9 ha plots. These adjusted numbers should be viewed as a likely under-estimate of the true densities.

4.0 References

Burnham, K.P. and D. Anderson. 1998. Model selection and inference: a practical information-theoretic approach. Springer-Verlag, New York, NY, USA.

Grant, T. 2005. Flat-tailed horned lizards (*Phrynosoma mcallii*): population size estimation, effects of off-highway vehicles, and natural history. Unpublished MS thesis, Colorado State University, Fort Collins.

Powell, L. 2007. Approximating variance of demographic parameters using the delta method: a reference for avian biologists. The Condor 109:949-954.

White, G.C. and K. P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46 Supplement, 120-138.