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August 9, 2010

Mr. Christopher Meyer
Project Manager
Attn: Docket No. 08-AFC-5
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Imperial Valley Solar (formerly Solar Two) (08-AFC-5)
Applicant's Re-Submittal of Exhibit 129- U.S. Army Corps of Engineers
Draft 404(b)1 Alternatives Analysis for the Imperial Valley Solar Project

Dear Mr. Meyer:

On behalf of Imperial Valley Solar (formerly Solar Two), LLC, URS Corporation Americas (URS) hereby re-submits the Applicant's Exhibit 129, U.S. Army Corps of Engineers Draft 404(b)1 Alternatives Analysis for the Imperial Valley Solar Project, dated July 16, 2010.

It was brought to our attention that the original submittal of Exhibit 129 was missing pages. This submittal provides a replacement of the previously docketed Exhibit 129.

I certify under penalty of perjury that the foregoing is true, correct, and complete to the best of my knowledge. I also certify that I am authorized to submit on behalf of Imperial Valley Solar, LLC.

Sincerely,

Angela Leiba
Project Manager

AL: ml

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U.S. Army Corps of Engineers
Draft 404(b)(1) Alternatives Analysis
For the Imperial Valley Solar Project (aka Solar II)

U.S. Army Corps of Engineers, Los Angeles District

Regulatory Division, South Coast Branch
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List of Acronyms and Abbreviations

Full Name	Acronym or Abbreviation
Above Market Funds	AMF
Application for Certification	AFC
Area of Critical Environmental Concern	ACEC
Army Corps of Engineers	ACOE
Best management practices	BMPs
Bureau of Land Management	BLM
California Energy Commission	Energy Commission
California Environmental Quality Act	CEQA
California Independent System Operator	CAISO
California Native Plant Society	CNPS
California Public Utilities Commission	CPUC
California Rapid Assessment Model	CRAM
Colorado River Regional Water Quality Control Board	RWQCB
Cubic feet per day	cfd
Cubic feet per second	cfs
Debt service coverage ratio	DSCR
Department of Energy	DOE
Designated Critical Habitat	DCH
Dollar per megawatt-hour	$/MWh
Drainage, Erosion and Sediment Control Plan	DESCP
Gallons Per Day	gpd
Federal Emergency Management Agency	FEMA
Federal Highway Administration	FHWA
Final Environmental Impact Statement	Final EIS
Flat-tailed horned lizard	FTHL
Interstate 8	I-8
Kilovolt	kV
Kilowatt	kW
Least Environmentally Damaging Practicable Alternative	LEDPA
Market Price Referent	MPR
Megawatt	MW
Milligram/liter	mg/L

Full Name	Acronym or Abbreviation
mmhos per centimeter	mmhos/cm
National Environmental Policy Act	NEPA
National Renewable Energy Laboratory	NREL
National Wetlands Inventory	NWI
Natural Resources Conservation Service	NRCS
Naval Air Facility	NAF
Peninsular bighorn sheep	PBS
Power conversion unit	PCU
Power Purchase Agreement	PPA
Programmatic Agreement	PA
Regional Water Quality Control Board	RWQCB
Renewable Portfolio Standard	RPS
Revised Universal Soil Loss Equation	RUSLE2
Right-of-way	ROW
San Diego Gas & Electric	SDG&E
Seeley Waste Water Treatment Facility	SWWTF
Soil Conservation Service	SCS
Soil erosion factor	K
Solar Programmatic Environmental Impact Statement	PEIS
Southern California Coastal Water Research Project	SCCWRP
Staff Assessment/Draft Environmental Impact Statement	SA/DEIS
Supplemental Staff Assessment	SSA
Standard Individual Permit	IP
Stormwater Pollution Prevention Plan	SWPPP
Tessera North America	TSNA
Total dissolved solids	TDS
United States Army Corps of Engineers	Corps
United States Department of Agriculture	USDA
United States Department of Defense	DOD
United States Environmental Protection Agency	EPA
United States Fish and Wildlife Service	USFWS
United States Geological Survey	USGS
Waters of the United States	WUS

1.0 Introduction

On November 4, 2009, U.S. Army Corps of Engineers (Corps) received an application from Tessera Solar North America (TSNA) (the Applicant) for a Section 404 Standard Individual Permit (IP) for the Imperial Valley Solar Project (IVSP) previously known as “Solar II”. The Applicant sought authorization to fill 165 acres of the total 881 acres of waters of the United States (WUS) supported on a 6,571 acre site (the site) located in Imperial County, California. The site is primarily on federal lands managed by the United Stated Department of the Interior, Bureau of Lands Management (BLM). The original project envisioned would have included the installation of solar generating facilities capable of generating up to 900 megawatts (MW) of electricity on approximately 7,650 acres of land. Site investigation by archeologists hired by the Applicant’s and BLM staff archeologists revealed that development in the eastern portion of the larger site would result in significant and unavoidable impacts to sensitive environmental resources. The project was therefore redesigned by the Applicant to avoid these impacts, resulting in a reduction of the developable area to 6,571 acres with the capacity of generating 750 MW of electricity. Since submittal of the Section 404 Corps permit application, the Applicant has further incorporated project revisions as a means of avoiding and minimizing impacts to WUS to the maximum extent practicable. As is described in detail below, this effort has resulted in the identification of project revisions that allow for the avoidance of impacts to aquatic resources (from 177 acres as proposed in the 900 MW Alternative to 38.2 acres of permanent direct impacts associated with fill material).

The following impact analysis is provided in accordance with Section 404(b)(1) of the Clean Water Act. To avoid duplication of pertinent information, there are multiple references to sections within the California Energy Commission (Energy Commission) Staff Assessment/Draft Environmental Impact Statement (SA/DEIS), released on February 12, 2010. The SA/DEIS and additional project details, status, copies of notices, and electronic version of documents filed with the Energy Commission are available under “Documents and Reports” at http://www.energy.ca.gov/sitingcases/solartwo/. The analysis within the SA/DEIS has been updated to reflect public comments and additional project information that is being presented in two separate documents, the Supplemental Staff Assessment (SSA) and Final Environmental Impact Statement (Final EIS.) This document is being provided as an appendix to the Final EIS. This draft 404(b)(1) alternatives analysis may be updated upon review of the SSA, further review of the Final EIS, and any new public comments prior to preparation of the Corps Record of Decision (ROD).

1.1 Regulatory Setting

Any activity requiring an IP under Section 404 of the Clean Water Act must undergo an analysis of alternatives in order to identify the Least Environmentally-Damaging Practicable Alternative (LEDPA) pursuant to the requirement of the guidelines established by the United States Environmental Protection Agency (EPA), known as the *Section 404(b)(1) Guidelines*. The *Section 404(b)(1) Guidelines* prohibit discharges of dredge or fill material into WUS if there is a "practicable alternative to the proposed discharge that would have less impact on the aquatic ecosystem, provided that the alternative does not have other significant environmental consequences." [40 C.F.R. § 230.10(a).]. An alternative is practicable "if it is available and capable of being done after taking into consideration cost, existing technology and logistics in light of the overall project purposes." [40 C.F.R. §§ 230.10(a) and 230.3(q).] "If it is otherwise a practicable alternative, an area not presently owned by an Applicant which could reasonably be obtained, utilized, expanded or managed in order to fulfill the basic purpose of the proposed activity may be considered." [40 C.F.R. § 230.10(a)(2).]

If the proposed activity would involve a discharge into a special aquatic site such as a wetland, the *Section 404(b)(1) Guidelines* distinguish between those projects that are water dependent and those that are not. A water dependent project is one that requires access to water to achieve its basic purpose, such as a marina. A non-water dependent project is one that does not require access to water to achieve its basic purpose, such as a housing development. Here, the Proposed Project is not water dependent.

The *Section 404(b)(1) Guidelines* establish two presumptions for non-water dependent projects that propose a discharge into a special aquatic site, such as a wetlands. First, it is presumed that there are practicable alternatives to non-water dependent projects, "unless clearly demonstrated otherwise." [40 C.F.R. § 230.10(a)(3).] Second, "where a discharge is proposed for a special aquatic site, all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise." [Id.] The thrust of the Guidelines is that Applicants should design proposed projects to meet the overall project purpose while avoiding impacts to aquatic environments. This approach is emphasized in a Memorandum of Agreement between the EPA and the Corps Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines (1990) ("MOA") as modified by the Corps and EPA Final Mitigation Rule (33 CFR Parts 325 and 332 [40 CFR Part 230]). The MOA articulates the Guidelines "sequencing" protocol as first, avoiding impacts, second, minimizing impacts, and third, providing practicable compensatory mitigation for unavoidable impacts and no overall net loss of functions and values. These presumptions do not apply to the IVSP as no special aquatic sites are directly impacted by the proposed project.

In addition to requiring the identification of the LEDPA, the *Section 404(b)(1) Guidelines* mandate that no discharge of dredged or fill material shall be permitted if it causes or contributes to violations of any applicable State water quality standard, 40 C.F.R. 230.10(b)(1), violates any applicable toxic effluent standard or prohibition, 40 C.F.R. § 230.10(b)(2), jeopardizes the continued existence of any endangered or threatened species (or destroy or adversely modify critical habitat), 40 C.F.R. § 230.10(b)(3), or causes or contributes to significant degradation of WUS, 40 C.F.R. § 230.10(c). Prior to completing its review, the Corps also must ensure that the proposed project is not contrary to the public interest. There are 20 public interest factors listed in 33 C.F.R. § 320.4.

1.2 Basic and Overall Project Purpose

Basic Project Purpose **–**The basic project purpose is used to determine whether a proposed project is water dependent (i.e., whether it requires a location that affects waters of the U.S.). The basic project purpose comprises the fundamental, essential, or irreducible purpose of the proposed project, and is used by the Corps to determine whether the applicant's project is water dependent. The basic project purpose for the Preferred Plan Alternative is: **"Energy Production."** The basic project purpose is not water dependent.

Overall Project Purpose – The overall project purpose serves as the basis for the Corps' Section 404(b)(1) alternatives analysis and is determined by further defining the basic project purpose in a manner that more specifically describes the Applicant's goals for the project, and which allows a reasonable range of alternatives to be analyzed. The overall project purpose is **"To provide a solar energy facility ranging in size from 300 Megawatts to 750 Megawatts in Imperial County, California."**

1.3 Location

TSNA Imperial Valley Solar Project, a proposed solar thermal electricity generation facility, would be located in Imperial County, California, primarily on public land managed by the BLM. The project site is approximately 100 miles east of San Diego, 14 miles west of El Centro, and 4 miles east of Ocotillo. The following sections or portions of sections within Township 16 of the San Bernardino Meridian, identify the project site and the planned boundary for development of the Imperial Valley Solar Project. A regional overview map is included in Figure 1 and the proposed project description is included in Figure 2. The project is proposed for location within U.S. Geological Survey (USGS) 7.5-minute map quadrangles; Plaster City, Painted Gorge, and a small portion on Coyote Wells.

- Within Township 16 South, Range 11 East of the San Bernardino Meridian defined by:
  - the portion of Section 7 south of the railroad right-of-way (ROW),
  - the portion of the southwest quarter section and the north half of the southeast quarter section of Section 9 south of the railroad ROW,
  - the southeast quarter-quarter section of the northeast quarter section and the east half of the southeast quarter section of Section 14 north of the Interstate 8 (I-8) ROW and east of Dunaway Road,
  - the southwest, northwest, and southeast quarter-quarter sections of the southwest quarter section of Section 15, and the southwest quarter-quarter of the southeast quarter section of Section 15,
  - the northwest quarter and southeast quarter of Section 16,
  - all of Section 17,
  - Section 18, excluding the southwest and southeast quarter-quarter sections of the northeast quarter section,
  - the northwest quarter and the portion of the west half of the southwest quarter of Section 19 north of the I-8 ROW,
  - the portion of Sections 20 and 21 north of the I-8 ROW, and
  - the portion of the north half of the northwest quarter section and the northwest quarter-quarter section of the northeast quarter section of Section 22 north of the I-8 ROW.
- Within Township 16 South, Range 10 East of the San Bernardino Meridian defined by:
  - the portions of Sections 12, 13, and 14 south of the railroad ROW,
  - the portions of Section 22 south of the railroad ROW,
  - all of Sections 23 and 24, and
  - the portions of Sections 25, 26, and 27 north of the I-8 ROW.

Generally, the proposed site boundary consists of the Union Pacific Railroad on the north and I-8 on the south. The eastern boundary is approximately 1½ mile west of Dunaway Road; and the western boundary is the westerly section line in Section 22 in Township 16 South, Range 12 East. An additional 125 acre construction area is located east of Dunaway Road. The proposed IVSP would also include an electrical transmission line, water supply pipeline, and a site access road. 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 (SWWTF) to the project boundary. The water supply pipeline would be routed in the Evan Hewes Highway right-of-way (ROW), or adjacent to this ROW on public and private lands. Approximately 7.56 miles of the 10.3-mile double-circuit generation interconnection transmission line would be constructed off-site. The transmission line would connect the proposed IVSP substation to the existing SDG&E Imperial Valley Substation. A site access road would be constructed from Evan Hewes Highway to the northern boundary of the project site as shown in Figure 2.

1.5 General Description

The proposed IVSP would be a 750 MW Stirling engine project, with construction planned to begin in the fall of 2010. The primary equipment for the generating facility would include approximately 30,000, 25-kilowatt (KW) SunCatchers (e.g. 30,000 x 25KW = 750,000 KW or 750MW), their associated equipment and systems, and their support infrastructure. The SunCatcher is a 25-KW solar dish that is designed to automatically track the sun and collect and focus solar energy onto a power conversion unit (PCU), which generates electricity. The system consists of a 38 foot high by 40 foot wide solar concentrator in a dish structure that supports an array of curved glass mirror facets. These mirrors collect and concentrate solar energy onto the solar receiver of the PCU. The SunCatcher dish is mounted on a 2 foot diameter, round steel pipe that is hydraulically vibrated into the ground to a depth of approximately 17 feet. No mass site grading is required to install the solar field.

The proposed 6,571 acre project site includes approximately 6,251 acres of federal land managed by the BLM and approximately 320 acres of privately-owned land.

The project would be constructed in two phases. 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 and have a net generating capacity of 300 MW. The renewable energy from Phase I would be transmitted via the existing 500-kilovolt (kV) SDG&E Southwest Powerlink transmission line. The project would be connected to the grid at the SDG&E Imperial Valley Substation via a 10.3-mile long, 230-kV interconnection transmission line that would be constructed as part of the project in a corridor parallel to the existing Southwest Powerlink transmission line. Phase I would require approximately 2,846 acres.

The 450-MW Phase II would add approximately 18,000 SunCatchers; expanding the project to a total of approximately 30,000 SunCatchers configured in 500 1.5-MW solar groups with a total combined net generating capacity of 750 MW. Phase II would require an additional approximately 3,725 acres of the project site. The additional 450 MW generated in Phase II would require a new transmission capacity within the grid. This is anticipated to be provided by the proposed 500-kV Sunrise Powerlink (or equivalent) transmission line (assumed to be a project independent of the Imperial Valley Solar Project). The construction and operation of Phase II is contingent on the development of either the Sunrise Powerlink transmission line or additional transmission capacity in the SDG&E transmission system.

The proposed IVSP would also include office and maintenance buildings, evaporation ponds, an electrical transmission line, water supply pipeline, a site access road, interior arterial and maintenance roads and a perimeter road. A new 230-kV substation would be constructed approximately in the center of the project site. This new substation would be connected to the existing SDG&E Imperial Valley Substation via an approximately 10.3 mile, double-circuit, 230 kV transmission line. Approximately 7.56 miles of the new line would be constructed off-site.

The water supply pipeline would be constructed a distance of approximately 11.8 miles from the SWWTF to the project site. The water pipeline would be routed in the Evan Hewes Highway ROW to Plaster City, entering the project site at that location. A site access road would be constructed from Dunaway Road to the eastern boundary of the project site, generally following an existing road.

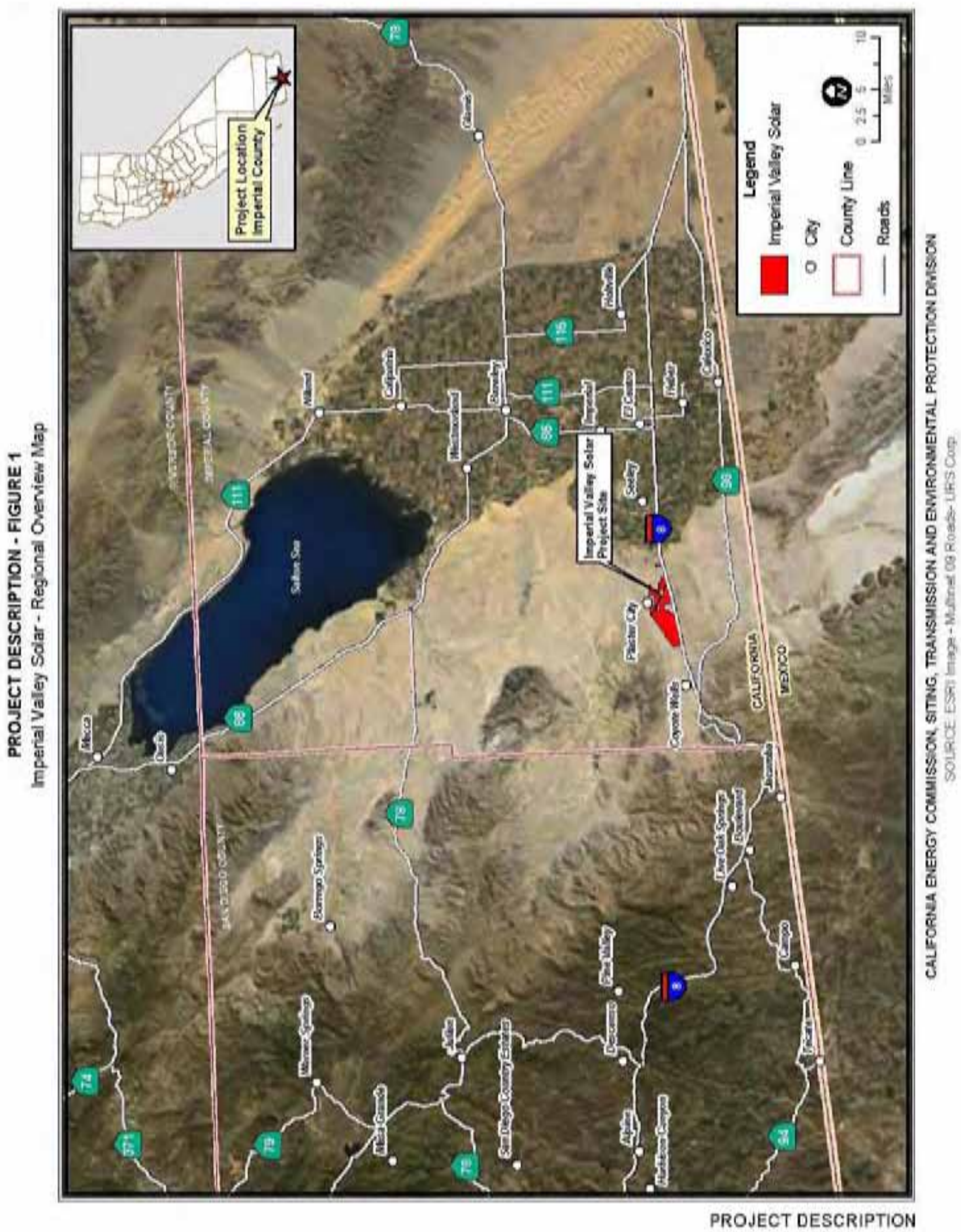

Figure 1. Regional Overview

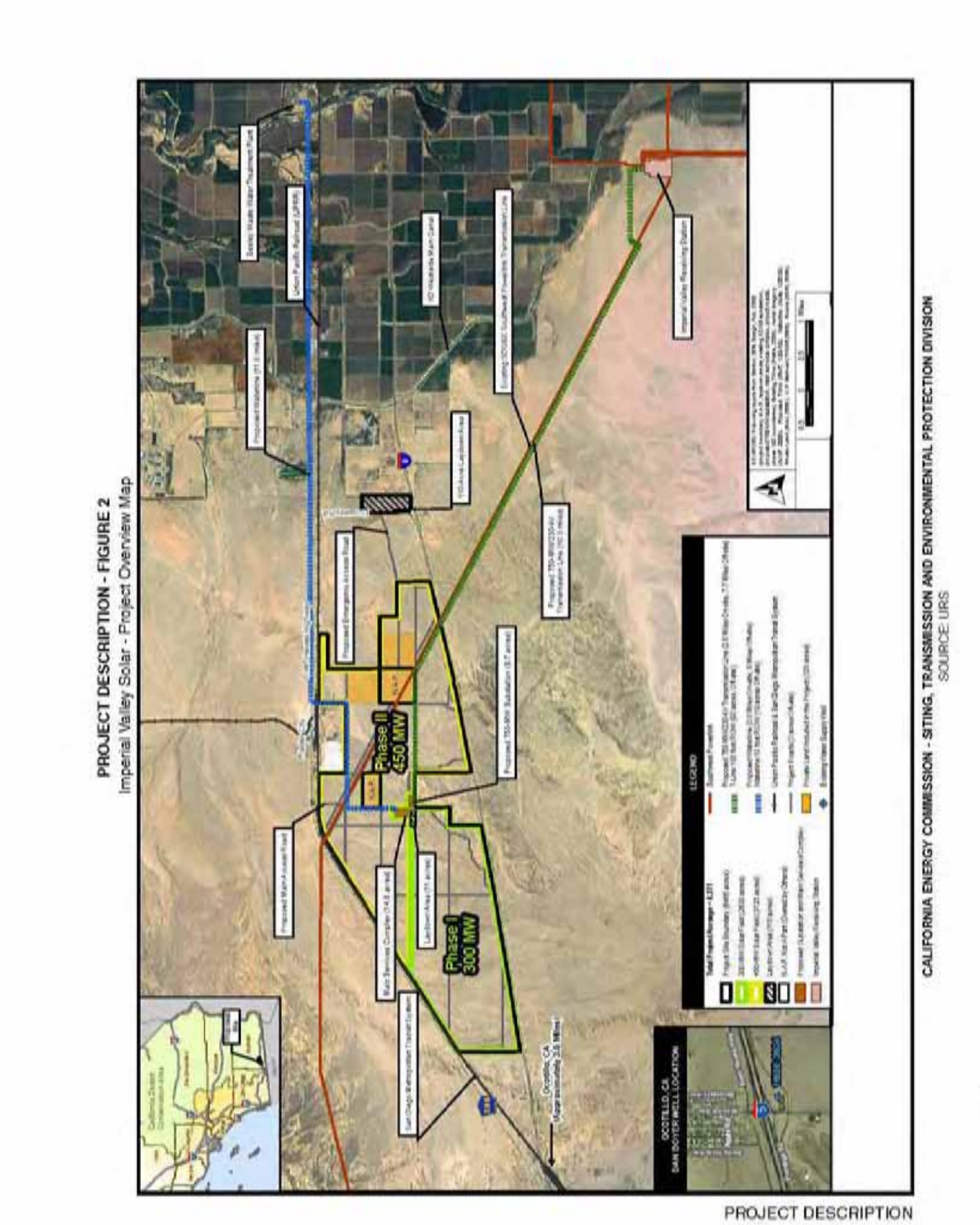

Figure 2. Proposed Project Description

2.0 Alternatives Analysis

2.1 Off-Site Alternatives

As described in the IP application and required by the *Section 404(b)(1) Guidelines*, the Corps evaluated alternative project sites to determine if there is an alternative site available on which the proposed project could be constructed that would involve fewer impacts to aquatic resources than the proposed project and would not have additional concomitant adverse impacts to other sensitive resources such as listed species. This involved a two-tiered review. First, alternative sites were subject to a detailed evaluation of the key siting criteria required for similarly sized, concentrating solar projects. Input was obtained on potential alternative locations through discussions with the Energy Commission, the California Independent Systems Operator, and the BLM. The "key siting criteria" are described below.

Key siting criteria include:

- **Size: The site must be able to support construction of a comparably sized solar energy facility that meets the overall project purpose, a minimum of 300MW and up to 750-MW of energy.**

- **Regional Location: The site must be located in an area of long hours of sunlight (low cloudiness), solar insolation should be at least seven kilowatt-hours per square meter per day (7 kWh/m2/day); the site must be relatively flat with a grade less than 5%; the site must have a wind speed less than 35 miles per hour 98% of the time.**

- **Proximity to Utilities: The site must be located in close proximity to high-voltage CAISO transmission lines with adequate capacity and must have an adequate water supply; the site must have ease of access for construction vehicles and close proximity to existing roads.**

- **Availability: The land must be available for sale or use as a utility-scale solar facility. Alternative sites must be available for purchase and development within a reasonable time frame (e.g. the number of parcels and landowners contribute to these criteria). Sites for which there is a pending application for use would not available for development of the proposed project.**

- **Constructability: The proposed use should be consistent with existing laws, ordinances, regulations and standards. Sites located within Department of Defense "no fly," "no build" areas would preclude installation of the proposed project.**

The following six off-site alternative sites were evaluated:

1. Alternative Site 1 (AS-1)
2. Alternative Site 2 (AS-2)
3. Alternative Site 2 (AS-3)
4. Mesquite Lake Site
5. Agricultural Lands
6. South of Highway 98

The locations of these off-site alternatives are shown in Attachment A. Additional detailed descriptions of these alternatives and a discussion of why they were selected are included in Section B.2 of the SA/DEIS and likely expanded in the SSA, which has not yet been reviewed by the Corps. Off-site alternatives were not analyzed as part of the Final EIS because they did not require any action by BLM (e.g. BLM can't issue a ROW on private land) and subsequently would not meet the BLM project purpose and need. These reasons are summarized in Section 2.8.2 of the Final EIS.

After evaluation with the siting criteria, each alternative that met these criteria was further screened for environmental impacts to WUS and sensitive species habitat to evaluate if they would be likely to have greater environmental impacts than the proposed project. If so, the alternative was not carried through the practicability analysis. In order to complete this comparison, the density and type of WUS, including wetlands and biological resources on each potential off-site alternative location were evaluated by the Applicant in December 2009 through additional field surveys and aerial interpretation site conditions. A summary of these findings and analysis are included in Table 1.

Environmental factors for post-siting screening:

- **Streams**: The density of intermittent streams, total length of intermittent or ephemeral streams, and total Corps WUS on the land should be similar to or less than the resources supported in the proposed project site. Table 1 includes the density and length of intermittent and ephemeral streams for each off-site alternative as mapped by the USGS National Hydrologic Dataset (USGS 2008). Potential WUS for each site was estimated using the acres of jurisdictional WUS for the proposed project site, the density of mapped intermittent and ephemeral streams for the proposed site, and extrapolating for the off-site alternatives. The WUS also include acres of wetlands mapped for the National Wetlands Inventory (NWI) as described below (USFWS 2008).

- **Presence of Special Aquatic Sites:** Special aquatic sites, including wetlands, afford additional protection under the CWA and provide habitat for sensitive wildlife species such as the Yuma clapper rail. In order to estimate the presence of special aquatic sites on each property, the Applicant provided a review of the National Wetlands Inventory (NWI) and provided the acres of mapped wetlands in Table 1 (USFWS 2008).

- **Presence of Federally-listed Species:** The Imperial Valley has several listed species as described in greater detail in Section 3.3.2. Table 1 includes acres of mapped potential habitat for the FTHL for the off-site alternatives (FTHL; ICC 2003) and for the Peninsular bighorn sheep (PBS; USFWS 2000).

2.2 Screening of Off-Site Alternatives

Table 1 provides a summary of the siting and environmental screening criteria for the off-site alternatives. Sections 2.2.1-2.2.6 provide details on why only offsite alternatives AS-3 and the Agricultural Lands meet the siting criteria.

Table 1. Summary of Off-Site Alternatives

Siting Criteria Measures	AS-1	AS-2	AS-3	Mesquite Lake	Agricultural Lands	South of Hwy 98
Land Area (acres)	7,195	8,818	5,007	5,112	4,103	5,833
Estimated MW[1]	830	1,017	578	590	473	672
Cost and Availability Criteria						
Number of Landowners	3+	2+	2+	**52**	3+	1
Number of Land Parcels	1	1	1	70	**7**	1
Available Land Use	No	No	Yes	Yes	**Yes**	Yes
Environmental Criteria						
Density of Intermittent Streams (Miles/Square Mile)	2.2	1.5	1.3	0	0.5	0
Length of Intermittent or Ephemeral Streams (Miles)	25.2	20.0	9.8	0	3.2	0
Waters of the US (acres)[2]	2,737	2,174	1,069	716	346	291
National Wetlands Inventory Wetlands[3]	0	0	0	716	0	291
Potential FTHL Habitat[4]	100.0%	100.0%	0.1%	0.0%	29.9%	
Designated USFWS PBS[5] Critical Habitat	10.6%	15.1%	0.0%	0.0%	0.0%	
Meets Siting Criteria?	**No** - Does not meet "constructability" criteria (e.g. located in DOD no-fly, no-build zone.)	**No** - Does not meet "constructability" criteria (e.g. located in DOD no-fly, no-build zone.)	**Yes**	**No** - Does not meet "availability" criteria (e.g. the number of landowners and parcels are substantially large). Additionally, this site supports a high number of wetlands relative to the project site	**Yes**	

1 – Assumes similar spacing as proposed project or 8.67 acres per MW (6,500 acres/750MW)

2 – Waters of the US were estimated for each site based upon the miles of intermittent or ephemeral streams within the alternative site (USGS 2008) and the acres of waters of the US mapped for the Proposed Project (881 acres).[3] – NWI mapping was obtained from the USFWS (2008).

4 – Potential FTHL habitat based on current distribution mapping from the FTHL Management Strategy (FTHL ICC 2003).

5 – PBS USFWS Critical Habitat Mapping was created by the USFWS in 2006.

2.2.1 Alternative AS-1

This 7,195 acre site is located primarily on BLM land (80%) with some private in-holdings (18%) and state lands (1%) [MVP1] and [MVP2] along the border between San Diego and Imperial counties approximately 30 miles north of the proposed project location as shown in Figure 1 of Attachment A. This site is located in a Department of Defense (DOD) "no-fly" and "no build" restricted area. In December 2007, OptiSolar, Inc submitted an application to the BLM for use of a portion of this site for construction and operation of a 500 MW photovoltaic solar facility.

Siting Criteria Review: Off-site Alternative AS-1 was eliminated as an alternative location for the proposed project because it is located within a DOD "no fly" and "no build" restricted area. Additionally, it is not available for development of the proposed project as there is an application pending for development of a photovoltaic solar facility on a portion of the site. This site does not meet the availability and constructability siting criteria.

2.2.2 Alternative AS-2

This 8,818 acre site is located primarily on BLM land (62%) with some private in-holdings (38%) east of AS-1 approximately 30 miles north of the proposed project location as shown in Figure 1 of Attachment A. This site is located in a DOD "no-fly" and "no build" restricted area. In December 2007, OptiSolar, Inc submitted an application to the BLM for use of a portion of this site for construction and operation of a 500 MW photovoltaic solar facility.

Siting Criteria Review: Off-site Alternative AS-2 was eliminated as an alternative location for the proposed project because it is located within a DOD "no fly" and "no build" restricted area. Additionally, it is not available for development of the proposed project as there is an application pending for development of a photovoltaic solar facility on a portion of the site. This site does not meet the availability and constructability siting criteria.

2.2.3 Alternative AS-3

This 5,007 acre site is located primarily on BLM land (96%) with some private in-holdings (4%) approximately 30 miles north of the proposed project location as shown in Figure 1 of Attachment A.

Siting Criteria Review: Alternative AS-3 meets the siting criteria and it was analyzed for practicability, the results of which are described below in Section 2.3.

2.2.4 Mesquite Lake

This site is disturbed land that is zoned for industrial use. Figure 2 of Attachment A shows the site boundaries and details. The Mesquite Lake site encompasses approximately 5,100 acres of land. However some of this land is already in use by the Holly Sugar Plant, the Mesquite Lake Recovery Facility, and the Imperial Valley Resource Recovery Plant. The Mesquite Lake Specific Plan Area is made up of approximately 70 parcels with 52 land owners.

Siting Criteria Review: The Mesquite Lake alternative site is not available for purchase and development within a reasonable timeframe due to the large number of parcels and individual land owners (e.g. 70 parcels and 52 landowners), which makes securing the site impracticable. Therefore, this site does not meet the “availability” criteria. Additionally, the Mesquite Lake site supports approximately 716 acres of wetlands roughly mapped by the National Wetlands Inventory (NWI) that may also be Corps jurisdictional wetlands WUS. Development of this site would likely result in greater impacts to WUS, particularly to wetlands relative to the proposed project site.

2.2.5 Agricultural Lands.

This site was considered because it would use some of the existing disturbed low-quality agricultural land in Imperial County (Figure 3 in Attachment A). This alternative consists of 25 parcels aggregated into 7 different parcel groups. The parcel groups range in size from 40 acres to 1,435 acres totaling approximately 4,100 acres. Figures 2 and 4 of Attachment A show the size and location of the seven disconnected parcel groups.

Siting Criteria Review: The Agricultural Lands Alternative meets the siting criteria and therefore it was analyzed for practicability, the results of which are described below in Section 2.3.

2.2.6 South of Highway 98.

The South of Highway 98 Alternative is located on BLM designated land that is operated by the Bureau of Reclamation (Figure 4 of Attachment A). This site was recently identified by the BLM and Department of Energy (DOE) for in-depth study completed for the preparation of a draft Programmatic Renewable Energy Environmental Impact Statement (PEIS). The maps obtained for this alternative were dated June 30, 2009. Figures 2 and 5 of Attachment A show the location of this site approximately four miles southeast of the greater El Centro area and along the US/Mexico international border. This site totals approximately 5,833 acres and the All American Canal flows through the site. National Wetlands Inventory (NWI) mapping for the area includes palustrine shrub/scrub and emergent wetlands adjacent to the All American Canal (USFWS 2008). The NWI mapping includes approximately 172 acres of palustrine scrub/shrub habitat and 6 acres of emergent wetlands within the alternative site boundaries. Assuming a project lay-out similar to the proposed project with a land requirement of 8.67 acres per MW, the land area of this alternative could accommodate approximately 672 MW.

Siting Criteria Review: The South of Highway 98 site meets the siting criteria; however, the site supports approximately 291 acres of wetlands roughly mapped by the National Wetlands Inventory (NWI) that may also be Corps jurisdictional wetlands WUS. Given the reduced size of the alternative site, the Corps assumes that substantial avoidance of these wetlands resources would not be practicable. Construction on this site would likely result in impacts to WUS, particularly to wetlands WUS compared to the proposed project which does not impact wetlands, that are greater than the proposed project. Therefore, the South of Highway 98 alternative site meets the siting criteria, but results in substantially more environmental effects and was subsequently not evaluated for practicability because it’s unlikely to be the LEDPA.

2.3 Practicability of Alternatives

2.3.1 Practicability Criteria

The following criteria were used to screen the practicability of off-site and on-site alternatives.

2.3.1.1 Project Purpose

To be practicable, an alternative must meet the overall project purpose, which is **"To provide a solar energy facility ranging in size from 300 Megawatts to 750 Megawatts in Imperial County, California."**

2.3.1.2 Cost Criteria

In order to be practicable, an alternative must allow for the creation of an economically viable utility-scale solar project. An alternative must allow for the generation of a sufficient amount of electricity at a low enough cost to allow for the sale of the electricity at a rate that is acceptable to the regulated utilities in California. This is calculated by integrating several major components, the cost of constructing the project, which is based primarily on the size of the project, and the price that the energy generated can be sold.

Practicability for the IVSP depends on TSNA being able to negotiate a PPA with a California electric utility that meets the capital and financing requirements for the project. The final terms of this agreement are determined by the price the utility is willing-to-pay for the power and by the costs to generate that power. Some of the factors that influence price and costs of power from the IVSP are discussed below. Fundamentally, the price of the electric power negotiated between a California utility and TSNA must not be higher than regulated price requirements, but the price must be high enough to cover project costs.

Price Ceiling

The price that California utilities are willing-to pay for electricity generated by the IVSP is set, in part, by the California Public Utilities Commission (CPUC) which regulates power purchases by California's largest utilities. Before a PPA is finalized, the CPUC must find that the prices in the PPA are fair and reasonable to consumers.

The CPUC sets a price ceiling for the purchase of renewable power in the annual Market Price Referent (MPR) [CPUC Resolution E-4298 December 17, 2009]. The MPR values are used in the RPS solicitations issued by electric utilities to purchase the power that they need to meet the RPS requirements[1]. In other words, the MPR values serve as the price reasonableness benchmark for renewable PPAs. The power provided by the IVSP falls into this category of power purchase.

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[1] The RPS program administered by the CPUC requires each utility to increase its total procurement of eligible renewable energy resources by at least one percent of retail sales per year so that 20 percent of the utility's retail sales are procured from eligible renewable energy resources no later than December 31, 2010.

In determining the reasonableness of RPS power purchase contracts, the CPUC compares the levelized all-in costs of each long-term RPS contract on a dollar per megawatt-hour ($/MWh) basis to the MPR, and to the prices in other renewable PPAs and bids by developers for renewable PPAs. The goal is to compare an RPS contract's costs to the costs of the presumptive conventional alternative such as natural gas-fired generation. The MPR is updated annually and driven primarily by natural gas prices. Since natural gas prices have dropped significantly between 2008 and 2009, the MPR is trending downward (see Table 2). In addition, rapidly dropping prices for photovoltaic (PV) panels has placed significant downward price pressure on PPA bids for non-PV solar projects.

Table 2. Comparison of 2008 and 2009 Market Price Referent Prices

PPA Contract Start Date	2008 MPR ($/MWh)	2009 MPR ($/MWH)	Difference between 2008 and 2009 MPR
2010	$ 113.90	$ 96.74	-18%
2011	$ 117.30	$ 100.98	-16%
2012	$ 121.26	$ 105.07	-15%
2013	$ 125.27	$ 108.98	-15%
2014	$ 128.97	$ 112.86	-14%
2015	$ 132.90	$ 116.47	-14%
2016	$ 137.06	$ 120.20	-14%
2017	$ 141.44	$ 124.04	-14%
2018	$ 146.03	$ 128.00	-14%
2019	$ 150.80	$ 132.09	-14%
2020	$ 155.78	$ 136.30	-14%

Utilities have the option to negotiate prices higher than the MPR and risk disapproval by the CPUC or they can tap into the Above Market Funds (AMF), if available. In SDG&E's case, the $69 million AMF allocation had been fully utilized by May 2009; SDG&E's AMF balance is zero. The combination of a decreasing MPR, exhausted AMF balances, and rapidly dropping PV prices is increasing pressure on renewable power generators such as TSNA to keep costs as low as possible and offer power at prices close to the MPR.

Cost of Electricity from Imperial Valley Solar Project

The cost of power from the IVSP is related to several factors including the cost to manufacture the Stirling Energy Systems SunCatchers and the capital cost to construct the project facilities. The cost of power from IVSP is premised on high volume production of SunCatchers. Each SunCatcher is assembled from component parts that are manufactured in former automobile manufacturing facilities in the United States. The cost to manufacture a single part is reduced with each additional part that is manufactured. The cost for a SunCatcher is reduced by as much as 50% if there is a high volume of SunCatchers manufactured compared to a low volume scenario. The higher cost for low volume manufacturing is due to the difficulty and cost premium required to get suppliers to dedicate manufacturing capacity to manufacture specialty parts for the SunCatcher, as well as higher materials costs because the materials that are purchased in lower quantities. Additionally, setup and tooling costs are spread across fewer parts. Therefore, for every MW that the IVSP is reduced by, the cost of each individual SunCatcher increases.

Similarly, the capital cost to construct a reduced MW IVSP would be higher on a $/MW basis because the cost of common facilities would be spread across fewer installed generators. Some of the common facilities that have to be constructed and sized the same, no matter what the size of the final IVSP include:

- Necessary transmission lines (10.3 miles of 230kV transmission lines on the proposed project site)
- Necessary water supply lines (11.8 miles of water supply line from the SWWTF for the proposed project site)
- Wastewater treatment facilities
- Hydrogen production facility
- Maintenance building
- Administration building
- Access roads

The arrangement of the SunCatcher generator groups also has a measurable impact on construction costs. For example, SunCatcher generator groups that are arranged in a standard grid format allow for standard cable and conduit lengths that can be pre-cut and installed directly. For non-standard generator groups, conduit and cables must be measured and cut on-site increasing labor and materials costs as well as increasing installation time. Therefore, construction costs would be higher the greater the number of non-standard SunCatcher generator groups that are included in a project.

Price Ceiling for Electricity from Imperial Valley Solar Project

TSNA has negotiated a PPA with SDG&E for the electricity generated by the IVSP. This PPA was negotiated assuming the costs and efficiencies associated with the proposed project (750 MW). Specifically, these assumptions include a construction cost of $2,950/kW or a total construction cost of $2,212,500,000. As discussed above, changes to the size, arrangement, or location of the proposed project would increase construction costs. SDG&E has stated that it would not under any circumstances increase the price paid for the energy generated by the IVSP. Therefore, the price ceiling for the IVSP is set by the PPA and any changes to the proposed project that increase costs would make the project less practicable. ***TSNA has determined that it is practicable to absorb an increase of $50 per kW; any increase in excess of this amount would render an alternative not practicable.***

2.3.1.3 Logistics Criteria

In order to be practicable, an alternative must allow for a cost effective layout of SunCatchers and related necessary infrastructure that minimizes ground disturbance and environmental impacts. There are a number of logistical considerations that constrain the engineering layout of the proposed action both on and off-site. These constraints include industry and/or regulatory design standards usually having to do with safety and in other cases are driven by design efficiencies having to do with cost controls and/or best engineering practices. These include:

SunCatcher Groupings:

- **Spacing:** SunCatchers must be spaced at least 60 feet x 112 feet apart and potentially farther apart depending on surrounding grade. Spacing is dependent upon the site latitude and the slope of the natural terrain. Shading will cause a differential heating of the SunCatcher heat exchanger which will adversely affect the operation and life of the Stirling Engine. Because of this spacing requirement, larger land parcels provide better configuration options to avoid sensitive resources (refer to siting criteria above).

- **Configuration:** SunCatchers must be bundled together in 1.5 MW (60 SunCatchers) and then into 9 MW generation groups (360 SunCatchers) in order to utilize standard utility electrical transformers and equipment. The SunCatcher units are required to be placed in a rectangular grid pattern in order to maximize the efficient conversion of solar energy directly into utility grade electric current. Configuring SunCatchers into non-standard configurations creates transmission and hydrogen system operation restrictions/inefficiencies due to the increase in resistance of the transmission lines and pressure drops in the hydrogen distribution system. A standard 1.5 MW group includes 7,000 feet of electrical wire and 7,000 feet of hydrogen piping (Figure 3). If the configuration changes from a standard group to a non-standard configuration as shown in Figure 3, the costs can increase up to 8% based upon the extra length and the efficiency of the electrical line decreases up to 3%, thus reducing overall plant output. The extra length of trenching needed to accommodate these non-standard configurations also increases ground disturbance (trenching) which increases impacts to site resources (soils, vegetation, etc.). The added length of utilities also increases compression requirements for the hydrogen system thereby increasing noise and emissions. Spreading out a 1.5 MW group lowers the efficiency of the system and increases the infrastructure and operation costs. ***For the proposed project, deviations of more than 50% of the generator groups to non-standard configurations would render the alternative impracticable.***

  The bundling of the 1.5 Mw and the 9 Mw generation groups allows the economic development of the SunCatcher field by having the ability to standardize lengths for electrical connection wires and hydrogen gas tubing. The electrical connections and hydrogen tubing connections can be precut and the ends terminated at the factory allowing better electrical terminations with the factory installed terminals for the electrical lines and leak free fittings for the welded hydrogen connections. The standardization of the electrical connections and hydrogen connections saves installation time, labor costs and material costs. The non-standard units require the installation field technicians to field measure each nonstandard run, cut the cable from a spool of wire or stainless steel tubing spool and hand fit the termination lugs for the electrical connections or field weld the connections for the hydrogen tubing.

- **Isolation:** The isolation of SunCatcher groups, removing groups from the site grid layout to accommodate resource or land feature avoidance, has an exponentially greater impact on operational design efficiency and cost relative to that described for standard versus non-standard generator group configurations. In some instances these factors would render an isolated group of SunCatchers impracticable due to logistics and cost. For example, if the placement of SunCatchers in Wash K and Wash A was avoided (Corps Drainage Alternative #1) the area of land between these drainages would not be utilized for any plant development. Length of utilities would have to be significantly lengthened in order to bundle utility crossings and roads into the fewest possible to return to the main layout grid. For this example over 45 utility and maintenance road crossings of these washes would have to be bundled into a number of crossings deemed adequate for meeting the purpose for the avoidance. Additionally, bundling utilities in this way would require that hydrogen system compressors be upsized due to the increase of friction loss within the distribution system from spreading out the SunCatcher field.

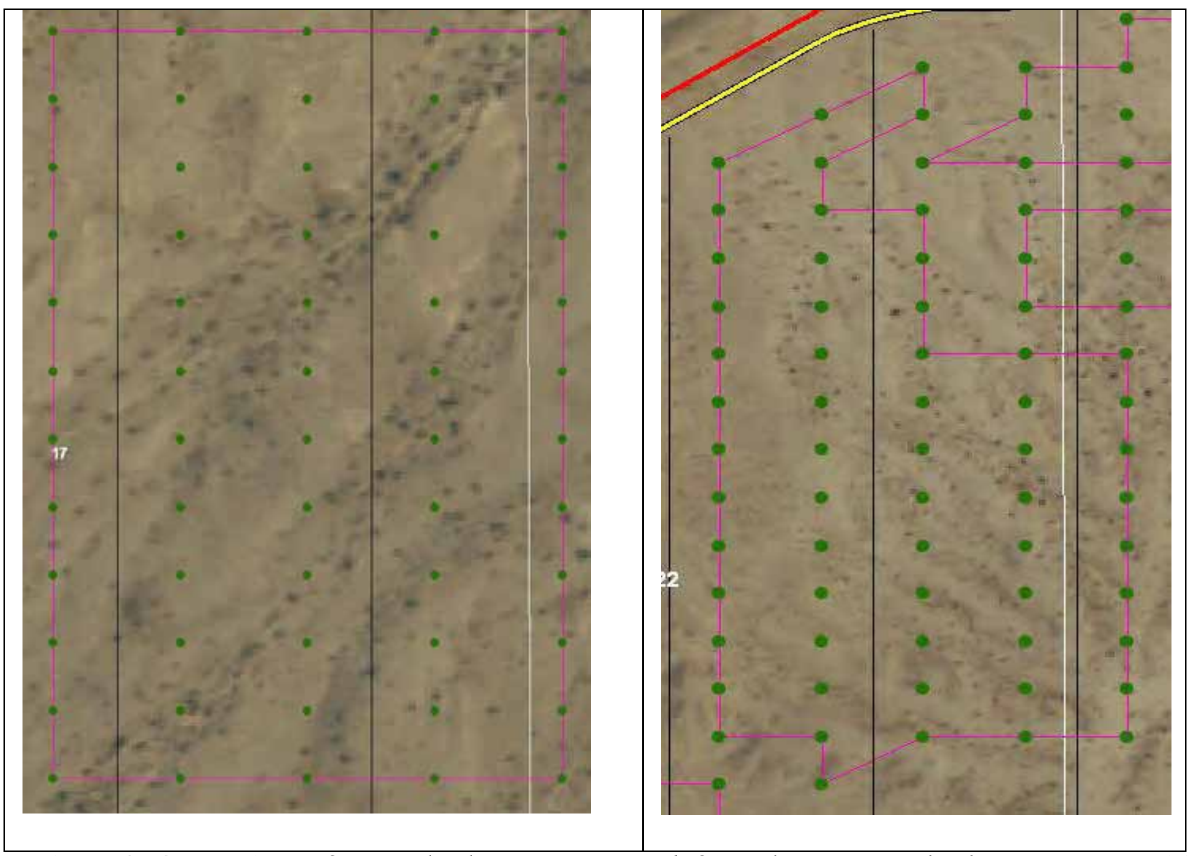

Figure 3. Comparison of a standard 1.5 MW group (left) and a non-standard 1.5 MW group (right).

- **Topography:** SunCatchers in rugged (hilly) terrain require grading to eliminate shading from one unit to the next and to create a safe operating slope for the maintenance cranes and lift equipment. The maintenance roadways that access SunCatchers rows also require additional earth work (at an additional construction cost) to insure worker and equipment safety during transportation and various maintenance operations. Maintenance slopes are limited to 10% for service crane safety. SunCatchers would not be installed where grades are greater than 5%.

Roads Layout:

- The arterial roads will serve as the main routes for maintenance technicians servicing the units. Maintenance roads 10 feet in width are placed between every other row of SunCatchers and are necessary for accessing the units by maintenance technicians to service and periodically wash the units. There will be a 10 foot wide perimeter road adjacent to the fence line for plant security as required by the Energy Commission.

- Each SunCatcher must be accessible from a road to allow for necessary maintenance; elimination of access roads would result in elimination of SunCatcher units and groups. Maintenance roads must be configured to avoid dead ends and ensuring that each connects to an arterial road, be no less than 10 feet wide, and only one way traffic will be allowed. Maintenance roads also need to be able to access every SunCatcher.

- Roadway widths are per American Association of State Highway and Transportation Officials Geometric Design of Highways and Streets, page 312, Paragraph 2, "Lanes 3.0 m [10 feet] wide are acceptable on low-speed facilities, and lanes 2.7 m [9 feet] wide are appropriate on low-volume roads in rural and residential areas."

Main Service Complex:

- In order to minimize costs for interconnection of the SunCatchers to the transmission grid, for travel access roads to the site, and for other common facilities that provide services to the entire project site, at any site utilizing the SunCatcher technology, the Main Services Complex needs to be approximately centrally located, providing the shortest average distance to the farthest points of the project site.

2.3.1.4 Technology Criteria

Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

2.4 Practicability of Off-Site Alternatives

In considering the practicability of the off-site alternatives that were not eliminated by the siting criteria (AS-3 and Agricultural Lands), the Corps analyzed alternative project configurations for each site. Table 3 summarizes the practicability analyses for the AS-3 and Agricultural Lands off-site alternatives. Sections 2.4.1 and 2.4.2 below provide further detail for each of the practicability criteria and explain why neither alternative is practicable.

Table 3: Summary of Off-Site Alternative Preliminary Project Design

Practicability Criteria	Alternative AS-3	Agricultural Lands
Meets Cost Criteria	**No -** The additional 17 miles of transmission line combined with the smaller overall capacity (578 MW) would increase the production approximately $140/kW compared to the proposed project.	**No** – The seven discontinuous sites would require additional infrastructure for power collection. In addition, the site's overall capacity is only 473 MW. This would increase production costs $259/kW compared to the proposed project.
Meets Logistics Criteria	**Yes**	**No** – The discontinuous parcels would require the construction of multiple isolated groups of SunCatchers. It would be infeasible to collect power from all of these parcels. In addition, there is no ideal site for a centrally located Main Services Complex, and reasonable road system and security fencing would not be possible.
Environmental Considerations	This alternative would have similar impacts onsite as the proposed project. However, the additional 17 miles of transmission line would increase off-site impacts by 193 compared to the proposed project.	Similar to the proposed project.
Practicable	**No**	**No**

[1] - Assumes similar spacing as proposed project or 8.67 acres per MW (6,500 acres/750 MW).

2.4.1 Off-Site Alternative AS-3

Overall Project Purpose: Off-Site Alternative AS-3 is estimated to have approximately 5,007 acres available for development. Assuming a project lay-out similar to the proposed project with a land requirement of 8.67 acres per MW, the land area of AS-3 could accommodate approximately 578 MW. This represents a reduction in 23% of the renewable energy, but meets the Overall Project Purpose due to its capability of producing between 300MW and 750MW of alternative energy.

Cost: Based on the preliminary design for this site, the cost to develop a project at this alternative location will be similar to the proposed project location except for the difference in transmission and water supply line costs. Assuming a cost of $1.5 million per mile for transmission line and $400,000 per mile for water supply line, the net cost difference between implementing the proposed project at the AS-3 location and the proposed location would be an additional $23.1 million, which amounts to approximately $40/kW. In addition, because the size of this site will only accommodate 578 MW, the construction costs for this project would be approximately $3,200/kW or $100/kW more than the proposed project. These additional construction costs are associated with low volume SunCatcher production and the cost of infrastructure facilities such as substations, transmission, and water supply being spread across a lower amount of total generation. Therefore, the estimated cost to construct a project at the AS-3 location would be approximately $140/kW greater than the proposed project. These exceed the cost criteria and would not be a practicable project.

Logistics: The logistics for the proposed project at the AS-3 location would be similar to the proposed project location except that 17 additional miles of right-of-way would be required for the extended length of overhead transmission line. There would be a 5.5 mile reduction in the length of right-of-way needed for the buried water supply pipeline. This alternative meets the logistics criteria.

Technology: Existing technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: Based on a review of aerial photographs of the site and other data available for the AS-3 location, the Corps estimates that there are approximately 9.8 miles of intermittent or ephemeral streams (USGS 2008) amounting to approximately 1,069 acres of WUS that could be impacted by development at this alternative location (Table 1). This is higher than the miles of intermittent or ephemeral streams and WUS at the proposed project location. Given the smaller size of the project site and therefore reduced opportunities to avoid aquatic resources at this location, it is assumed that development of the proposed project at this location would result in a higher level of impacts to WUS.

AS-3 is located in similar desert scrub habitat to the proposed site and it is expected that similar wildlife species to the proposed site would be present. The Mesa Flat-tailed Horned Lizard Management Area is located immediately adjacent to the west side of the site; however, the entire site is located just outside of mapped potential FTHL habitat. The desert scrub habitat is likely potential forage habitat for PBS and designated critical habitat is 11 miles west of the site. This alternative was not evaluated in detail in the SA/DEIS or SSA because the Energy Commission noted that it would have similar impacts as the proposed project (CEC 2010) and thus no reduction to environmental affects would be achieved.

Conclusion: This alternative does not meet the cost criteria and would result in greater environmental impacts due to greater disturbance to surface resources; therefore, it is not likely to result in the LEDPA.

2.4.2 Agricultural Lands

Overall Project Purpose: The Agricultural Lands Off-Site alternative is estimated to have about 4,103 acres available for development. Assuming a project lay-out similar to the proposed project with a land requirement of 8.67 acres per MW, the land area of this alternative could accommodate approximately 473 MW. This represents a reduction in 37% of the renewable energy, but it meets with the overall project purpose due to its capability of producing between 300MW and 750MW of alternative energy.

Cost: Based on a preliminary design for this location, it is estimated that approximately 4.5 miles of transmission line and 1.5 miles of water supply line will be required. Because this off-site alternative is comprised of seven different land parcels across a 100 square mile area, there would be additional costs for a power collection system including an additional substation. Assuming a cost of $28.1 million for additional power collection, the net cost difference between implementing the proposed project at the Agricultural Lands location and the proposed location would be an additional $4.1 million or $9/kW. In addition, because the size of this site will only accommodate 473 MW, the construction costs for this project would be approximately $3,200/kW or $250/kW more than the proposed project. These additional construction costs are associated with low volume SunCatcher production and the cost of infrastructure facilities such as substations, transmission, and water supply being spread across a lower amount of total generation. Therefore, the estimated cost to construct a project at the AS-3 location would be approximately $259/kW greater than the proposed project. These exceed the cost criteria and would not be a practicable project.

Logistics: The logistics for the proposed project at the Agricultural Lands location would be very problematic relative to the proposed project location as SunCatcher groups and utilities and roads would be dispersed across seven discontinuous different land parcels. This fragmentation of the development area would not allow for a similar continuous grid layout as the proposed action and therefore would likely be smaller than the estimated 473 MWs. The irregular configuration of the facility, essentially building isolated groups of SunCatchers, does not provide for cost efficient generation of power nor a reasonable utility collection or transportation network for the site(s). Further, it is uncertain that this site could accommodate a centrally located main services complex nor be reasonably secure as no perimeter fence or road would be possible. This alternative does not meet several logistics criteria.

Technology: Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: Based on a review of aerial photographs, field visits by the applicant, and using data available for this location, the Corps recognizes that there are several different potentially jurisdictional water features within the seven parcels that constitute the Agricultural Lands Alternative. Parcel BL-1 is located on the edge of the agricultural lands and a small section of desert scrub habitat with 0.4 miles of ephemeral streams mapped. The remaining parcels (BL-2 to BL-7) are located within the agricultural lands of the Imperial Valley. There are approximately 9.7 miles of mapped canals that traverse these parcels that may or may not have adjacent wetland areas. In addition, Greeson Wash bisects parcels BL-4 and BL-5 and is mainly fed by irrigation. During a site visit, it was observed that parcel BL-4 has patches of tamarisk and common reed (*Phragmites australis*). It is likely that the ephemeral washes within BL-1, some portion of the irrigation ditches, and Greeson Wash would be considered jurisdictional by the Corps. Given the smaller size of the project site and therefore reduced opportunities to avoid aquatic resources at this location, it is assumed that development of the proposed project at this location would result in a higher level of impacts to both intermittent and ephemeral WUS.

Parcel BL-1 is located on fallow agricultural fields which has reverted back to Sonoran mixed salt desert scrub and Colorado desert wash scrub which is similar to the proposed project. This parcel would have similar wildlife species to the proposed project site including potential FTHL habitat.

Conclusion: This alternative would not meet the cost or logistics criteria and is not a practicable alternative.

2.5 On-Site Alternatives

The Corps evaluated four on-site alternatives to the proposed Project described in the Army Corps IP application that could possibly reduce impacts to WUS. Each of these alternatives was analyzed using practicability screening criteria to help identify the LEDPA. In addition to the proposed project and these four alternatives, this document also includes an analysis of the 900 MW facility initially proposed to help demonstrate the level of avoidance that has been incorporated into the revised project design beginning prior to the Corps involvement in the project though development of the 709MW alternative. Finally, this document also evaluates a no fill alternative. The on-site alternatives are described as follows:

Alternative #1 – Applicant's Proposed Project (750-MW Project). See Section 1.3 above for more information regarding the proposed action. The Applicant's original proposed project would permanently fill approximately 177 acres of jurisdictional WUS, would incur 5.2 acres of temporary impacts, and 13 acres would be indirectly affected on the project site through scour (See Map 3 in Attachment B). This alternative would permanently impact approximately 6,500 acres of FTHL habitat, which would be mitigated through in-kind purchase agreements. A small herd of five PBS was observed on the site in Marcy, 2009. This is considered an unusual occurrence because of no known lambing sites or water sites near the project site and no other PBS occurrences have been documented in the vicinity. Nonetheless, the USFWS has determined that the site may be used by PBS during migration or under extreme conditions such as drought and that the site supports approximately 250 acres of potential PBS foraging habitat (28% of the 881 acres of WUS). No direct take of federally listed species are expected to occur, but the USFWS is preparing a Biological Opinion (BO) for the potential adverse effects of the proposed project through loss of foraging habitat. Effects of this alternative would be complete removal of potential PBS foraging habitat through installation of the perimeter fence. The Applicant's Proposed Project could affect at least a 20% subset of approximately 337 known prehistoric and historical surface archaeological resources and may affect an unknown number of buried archaeological deposits, many of which may be determined historically significant. Effects to cultural resources were described in section 4.5 of the Final EIS would be mitigated under a Programmatic Agreement (PA).

Alternative #2 - Maximum Energy Generation Alternative (900-MW Project). The 900-MW Alternative was the original proposed Applicant Project. During the environmental review process conducted by the Applicant, the 750-MW Project later became the preferred Project to help avoid potential significant environmental impacts (specifically to cultural resources). The 900-MW Alternative was to be constructed on approximately 7,600 acres of land that extended east of the current project boundary to Dunaway Road. The 900-MW Alternative was proposed to be built in two phases. Phase I of the 900-MW Alternative would essentially correspond with both the 300-MW Alternative described below (Alternative 4) and Phase I of the 750-MW Project (Alternative 1). Phase II of the 900-MW Alternative would expand Phase I of the 750-MW Project with an additional 600 MW of generating capacity. In total, approximately 36,000 SunCatchers would be required for the 900-MW Alternative.

The Corps worked with the Applicant to determine the extent of jurisdictional WUS within the proposed 750MW alternative (Alternative 1) as described later in section 3.1.1. During that evaluation process, the Corps also requested assisted in the interpretation of aerial photographs and hydrologic data to generate a map of potential WUS into the additional 1,100 acres necessary for the 900 MW Alternative (Map 4 in Appendix B.) Extrapolating from the impacts to WUS from the original site plan (750 MW), it is estimated that the 900 MW alternative would have more than 205 acres and likely up to 250 acres of permanent impacts due to the nature of the WUS in this area spreading into wide braided alluvial fans. In addition, the 900MW alternative would use the same waterline as the 750 MW alternative maintaining the same acres of temporary impacts (5.2 acres). This Alternative would impact an additional 1,100 acres of FTHL habitat, potentially 363 acres of PBS foraging (28% of the 1,298 acres of WUS) habitat would be unavailable due to the perimeter fence, and would impact an area with a high density of cultural resource sites The project was reduced to the 750 MW Proposed project to avoid these additional impacts, particularly the additional impacts to cultural resources.

Alternative #3 - Modified Project to Avoid the Highest Flow Resources. This alternative was designed to test the practicability of avoiding impacts to the highest flow streams on the site. It allows for the generation of approximately 709 MW while significantly reducing impacts to aquatic resources. This alternative avoids the entirety of washes I, H, K, and C and avoids all of washes E and G southwest of the transmission line corridor as well as providing a 200 foot wide flow corridor in washes E and G northeast of the transmission line corridor. The Corps has been working with the Applicant since the preparation of the SA/DEIS to maximize avoidance of to WUS. In order to accomplish the avoidance demonstrated in the alternative, the Applicant has redesigned the project substantially, including moving the Main Services Complex and narrowing roads. The following is a list of avoidance, redesign, or minimization measures taken to reduce impacts to WUS to the maximum extent practicable:

Primary Design Modifications in order to Maximize Avoidance and Minimization to WUS:

1. Reduced total generating capacity from 750 MW to 709 MW allowing for the complete avoidance of ephemeral main-stem streams H, I, K, and C, as well as complete avoidance of the majority of stream G and the upper half of stream E (Map 5 of Attachment B). This removed 1,163 SunCatchers from WUS and reduced permanent impacts from 177.4 acres to 38.2 acres. The streams chosen for avoidance were based primarily on flow characteristics, but also on the Corps qualitative evaluation of the stream condition in the field prior to the CRAM analysis described in section 3.1.2. The Corps qualitative evaluation was substantiated by the CRAM analysis since 4 of the 6 main stem stream avoided in this alternative are among the highest scoring. The only high scoring stream not avoided in this alternative is D and it is located in the approximate center of the project site flowing from south to north.

2. SunCatchers were removed from 200 foot corridors in the northern sections of ephemeral main-stem streams E and G. This reduced the number of SunCatchers in WUS by 228. These corridors combined with the complete avoid of the streams south of the transmission corridor provide unobstructed hydrologic and sediment transport and FTHL with clear routes to travel across the proposed project area (Map 5 of Attachment B).

3. Reduced the number of the east-west roads to minimize the number of roads in washes and the number of wash crossings.

4. The waterline that extends to the SWWTF was shifted and co-located beneath a site arterial and maintenance roads to reduce temporary impacts to WUS to 0.0 acres.

5. Reducing the width of SunCatcher maintenance roads from 15 feet to 10 feet which is the narrowest road width allowed by industry standards.

6. The removal of spur roads to individual SunCatchers from the maintenance road that runs down the middle of the two roads of SunCatchers (Figures 4 and 5). This increases the temporary disturbance for the construction of the SunCatchers by the use of a temporary 50-foot road that includes the 2-foot wide trench for the installation of an underground utility line and hydrogen pipeline, but decreases the permanent impacts to WUS substantially.

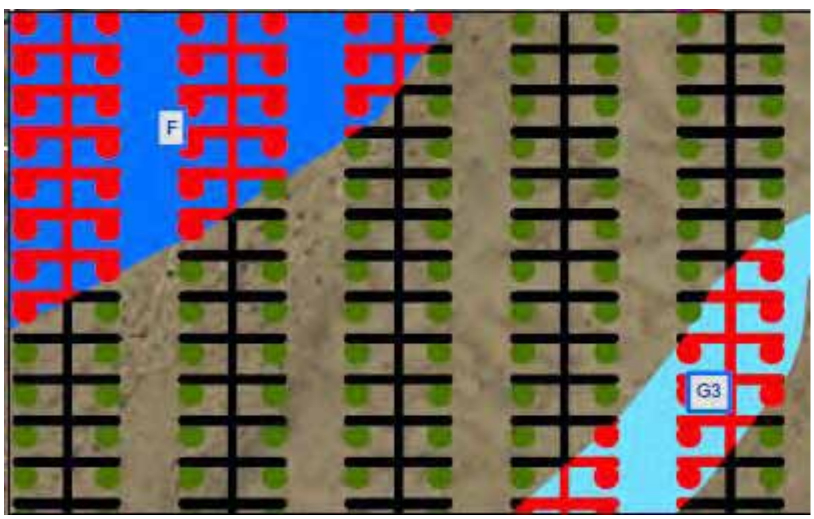

Figure 4. Orginal design for access roads to the SunCatchers that includes the 55 foot spur roads to each Sun Catcher.

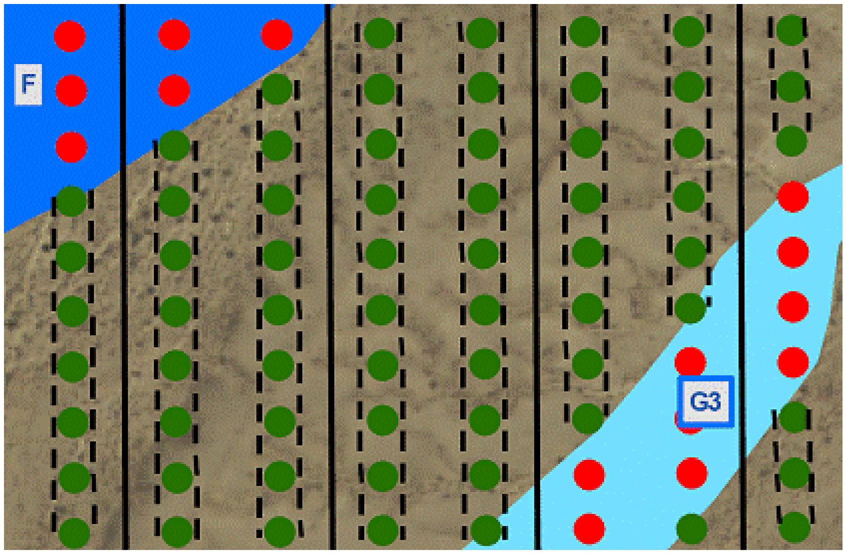

Figure 5. Current design for the SunCatchers and Maintenance roads. Dashed lines are utility trenches for the electrical and Hydrogen distribution lines.

7. Originally, sediment basins were proposed to retard water flow through the property and trap sediment. Hydrology and sediment modeling determined that the sediment basins would substantially change the pattern of sediment delivery for the ephemeral streambeds and result in a deficit of sediment transport downstream (Chang Consultants 2010a). The Applicant removed the sediment basins from the proposed project as a result of these findings which decreased the permanent impacts to WUS by 3.3 acres and reduced impacts to sediment transfer through the project area.

8. The Main Services Complex was moved north to move it out of a secondary wash complex. This reduced permanent impacts to WUS by 17.4 acres. In addition, it removed the two retention ponds from the wash and reduced the risk of pollutants entering the ephemeral wash system.

9. The main access road crosses Wash G and the crossing originally was planned to use culverts. Chang's initial report indicated that the culvert crossing would impede sediment and alter downstream sediment transfer (Chang 2010a). The crossing was changed to a precast concrete arches culvert system (like a bridge) that will not alter the downstream sediment transfer.

The Applicant proposes numerous other avoidance and minimization measures that are intended to reduce, ameliorate, and/or avoid potential adverse effects on the aquatic ecosystem and wildlife. These measures are outlined in the Proposed Conditions of Certification Sections of the Biological Resources and Soil and Water Resources portions of the SA/DEIS and individual Mitigation, Project Design Features, and Other Measures within sections 3.3 and 4.3 of the Final EIS.

The Alternative would result in permanent impacts to approximately 38.2 acres of jurisdictional WUS and would incur 10.8 acres of temporary impacts. This is a reduction of 138 acres (78 % reduction) of permanent impacts to WUS. This alternative would permanently impact approximately 6,000 acres of FTHL habitat, which would be mitigated through in-kind purchase agreements. Within the 709MW Alternative there is approximately 250 acres of potential PBS foraging habitat (28% of the 881 acres of WUS). No direct take of federally listed species are expected to occur. Effects of this alternative would be complete removal of potential PBS foraging habitat through installation of the perimeter fence.

This Alternative could affect at least a 20% subset of approximately 337 known prehistoric and historical surface archaeological resources and may affect an unknown number of buried archaeological deposits, many of which may be determined historically significant. Effects to cultural resources would be mitigated under a PA.

Alternative #4 - 300 MW Alternative. This alternative was designed to test the practicability of limiting the project to Phase 1 and would allow for the construction of a nominal 300 MW facility. This Alternative would reduce the disturbance area to 2,846 acres (40% of the proposed action). The Alternative would result in permanent impacts to approximately 27 acres of jurisdictional WUS and would incur 7.3 acres of temporary impacts. It would likely result in an incremental reduction in potential effects to FTHL habitat, and cultural resources by approximately 60%. Within the 300MW Alternative there is approximately 79 acres of potential PBS foraging habitat (28% of the 283 acres of WUS). No direct take of federally listed species are expected to occur. Effects of this alternative would be complete removal of potential PBS foraging habitat through installation of the perimeter fence. Effects to cultural resources would be mitigated under a PA.

Alternative #5 - Drainage Avoidance #1 Alternative. This alternative was designed to test the practicability of avoiding permanent impacts to the 10 primary ephemeral washes found within the proposed project area. Approximately 5,600 acres of the 6,500-acre site would be developed (86% of the proposed action). This alternative would reduce permanent impacts to jurisdictional WUS from 177 acres to approximately 38 acres and reduce energy production from 750 MW to 606 MW. Effects to FTHL habitat would be reduced incrementally in proportion to the reduction in acres of impact. Impacts to PBS foraging habitat would be the same as with the 750MW and 709MW Alternatives, there is approximately 250 acres of potential (28% of the 881 acres of WUS). No direct take of federally listed species are expected to occur. Effects of this alternative would be complete removal of potential PBS foraging habitat through installation of the perimeter fence. Effects to cultural resources would be mitigated under a PA.

Alternative #6 - Drainage Avoidance #2 Alternative. This alternative was designed to test the practicability of eliminating development in the eastern and westernmost portions of the project site essentially shrinking the project footprint to the center of the property. Drainage Avoidance #2 Alternative would avoid the largest ephemeral drainage complexes and many more of the cultural resources on the eastern portion of the property. It would reduce the disturbance area to 3,590 acres (55% of the proposed action), would reduce permanent impacts to WUS from 177 acres to 36.7 acres, and would reduce energy production to 438 MW. The impacts to FTHL habitat and to FTHL populations would be decreased by approximately 45%. Impacts to PBS foraging habitat would be the same as with the 750MW and 709MW Alternatives, there is approximately 250 acres of potential (28% of the 881 acres of WUS). No direct take of federally listed species are expected to occur. Effects of this alternative would be complete removal of potential PBS foraging habitat through installation of the perimeter fence. Effects to cultural resources would be incrementally reduced in proportion to the reduced acres of impacts and mitigated under a PA.

Alternative #7 - No Project/No Development Alternative. The No Project/No Development Alternative assumes that there are no project approvals in effect, and no future development of the project area would occur. This alternative would avoid the adverse effects associated with construction of the project and operation and would therefore preserve all WUS and FTHL habitat and PBS potential foraging habitat on-site. The project area would remain it its existing condition or would continue to degrade and be subject to further trash deposition, off-road vehicles, weed infestation from on-going disturbances, and other transient use. Given the dispersal of aquatic resources located on the site, it was determined that the No Project Alternative described in the SA/DEIS and Final EIS is equivalent to the no fill alternative as it would be impossible to construct a large scale solar project on the site without impacting some aquatic resources.

2.6 Practicability of On-site Alternatives

In considering the practicability of the on-site alternatives, alternative site configurations were evaluated for each alternative. Onsite alternatives #1 thru #4 were alternatives designed by the applicant's engineers, while alternatives #5 and #6 were drainage avoidance alternatives generated by the Corps. Table 4 below summarizes the results for the practicability analyses for each of the on-site alternatives. Sections 2.6.1-2.6.6 provide the detailed practicability analyses for each alternative.

Table 4. Practicability of onsite alternatives including cost and logistics criteria.

Practicability Criteria	Alt #1 Proposed Project	Alt #2 Max Gen	Alt #3 Highest flow Avoidance	Alt #4	Alt #5	Alt #6
Cost Criteria						
Size of Project (MW)	750	900	709	300	606	438
Cost $/kW	$2,950	$2,900	$3,000	$3,200	$3.050	$3,200
Difference in Construction Cost from Proposed Project	-	-$45,000,000	+35,400,000	+75,000,000	+60,600,000	+109,500,000
Meets Cost Criteria	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**
Logistics Criteria						
Number of Std/Non-Std Generator Groups	450/50	600/0	474/215	204/74	405/216	286/108
Percentage of Non-Std Groups	11%	0%	45%	36%	53%	38%
Isolated SunCatcher Groups	No	No	No	No	Yes	No
Centrally located Main Services Complex	Yes	Yes	Yes	Yes	Yes	No
Meets Logistics Criteria	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**Yes**
Impacts to WUS						
Permanent WUS Impacts (acres)	177	205	38.2	27	38	31.9

Practicability Criteria	Alt #1 Proposed Project	Alt #2 Max Gen	Alt #3 Highest flow Avoidance	Alt #4	Alt #5	Alt #6
Temporary WUS Impacts (acres)	5.2	5.2	14.0	7.3	12.5	10.4
Practicable Alternative?	**Yes** – Larger impacts to WUS make it unlikely to result in the LEDPA.	**Yes** -Larger impacts to WUS and cultural resources make it unlikely to result in the LEDPA.	**Yes**	**No** – Does not satisfy cost criteria to produce electric power at a price regulated utilities can pay.	**No** – Does not satisfy cost criteria to produce electric power at a price regulated utilities can pay and would require isolated SunCatcher groups and greater than 50% of non-standard Generator Group.	**No** – Does not satisfy cost criteria to produce electric power at a price regulated utilities can pay.

2.6.1 Alternative #1 - Applicant's Proposed Project

Overall Project Purpose: The proposed project would allow for the generation of 750 MW of utility grade electricity (Map 3 of Attachment B). The proposed project would meet approximately 84.1% of SDG&E's renewable energy requirements. This alternative satisfies the overall project purpose due to its capability of producing between 300MW and 750MW of alternative energy.

Cost: The proposed project would allow for the generation of 750 MW at a cost of approximately $2,950 per kW. The estimated total construction cost for 750 MW is $2,212,500,000. The construction costs for this alternative were used to negotiate the PPA with SDG&E and do not exceed the cost threshold determined by prices in the agreement. This alternative meets the cost criteria.

Logistics: The proposed project allows for the installation of 30,000 SunCatcher™ units that can efficiently be grouped into 360 SunCatcher™ groups, allowing for the efficient generation and transmission of electricity generated. It allows for the installation of perimeter, arterial and maintenance roads necessary to service each of the SunCatcher groups and to meet necessary safety and security requirements. Utilities can be installed to serve each of the units and the central facilities complex can be located in the center of the project site. This alternative meets the logistics criteria.

Technology: Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: This alternative would result in 177 acres of permanent impacts and 5.2 acres of temporary impacts to WUS (Table 5)

Table 5. Permanent and temporary impacts to waters of the U.S. associated with Alternative #1.

Impacts		Permanent (Acres)		Temporary Acres	
		Primary	Secondary	Primary	Secondary
Roads	Main Access	0.7	0.5	0.0	0.0
	Maintenance	109.8	43.2	0.0	0.0
Debris Basins		3.3	1.5	0.0	0.0
SunCatchers (2 ft diameter)[1]		0.3	0.1	0.0	0.0
Main Services Complex		7.1	10.9	0.0	0.0
Waterline		0.0	0.0	5.2	0.0
Electrical Distribution		Included in maintenance road impacts			
Total		121.2	56.2	5.2	0.0

[1] – Impacts for the SunCatcher pedestals were calculated at 8.86×10^{-5} acres (4 square feet) per pedestal (4,528 pedestals total).

Conclusion: This alternative is practicable considering cost and logistics, and would meet the overall project purpose, but would have more impacts to environmental and cultural resources than the 709MW Alternative and therefore is not likely to result in the LEDPA.

2.6.2 Alternative #2 - Maximum Energy Generation Alternative

Overall Project Purpose: Alternative 2 would involve the construction of a facility capable of generating 900 MW of utility quality electricity (Map 4 of Attachment B). This would provide approximately 100% of SDG&E's renewable energy requirements and exceeds the overall project purpose of generating between 300 and 750MW.

Cost: This alternative would allow for the generation of 900 MW at a cost of less than $2,900 per kW. The estimated total construction cost for 900 MW is $2,610,000,000. The costs for this alternative are less than those used to negotiate the PPA with SDG&E and do not exceed the cost threshold determined by prices in that agreement. This alternative meets the cost criteria.

Logistics: This alternative allows for the installation of 36,000 SunCatcher units that can efficiently be grouped into 360 SunCatcher groups, allowing for the efficient generation and transmission of electricity generated. It allows for the installation of perimeter, arterial, and maintenance roads necessary to service each of the SunCatcher groups and to meet necessary safety and security requirements. Utilities can be installed to serve each of the units and the main facilities complex can be located in the center of the project site. This alternative meets the logistical criteria.

Technology: Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: This alternative would result in approximately 205 acres of permanent impacts and temporary impacts to 5.2 acres of WUS (Table 6).

Table 6. Permanent and temporary impacts to waters of the U.S. associated with Alternative #2.

Impacts		Permanent (Acres)[1]		Temporary Acres	
		Primary	Secondary	Primary	Secondary
Roads	Main Access	0.8	0.6	0.0	0.0
	Maintenance	128	51	0.0	0.0
Debris Basins		3.9	1.8	0.0	0.0
SunCatchers (2 ft diameter)[2]		0.4	0.1	0.0	0.0
Main Services Complex		7.1	10.9	0.0	0.0
Waterline		0.0	0.0	5.2	0.0
Electrical Distribution		Included in maintenance road impacts			
Total		140.2	64.4	5.2	0.0

[1] – Permanent impacts were extrapolated using the permanent impacts from Alternative #1 and the 900 MW footprints (7,600 acres).
[2] – Impacts for the SunCatcher pedestals were calculated at 8.86×10^{-5} acres (4 square feet) per pedestal.

Conclusion: This alternative would be practicable in terms of cost and logistic criteria and would meet the overall project purpose. Although practicable, this alternative would not result in a reduction of impacts to aquatic resources and therefore is not likely to result in the LEDPA.

2.6.3 Alternative #3 - Modified Project to Avoid the Highest Flow Resources Alternative

Overall Project Purpose: This alternative would allow for the generation of 709 MW of utility grade electricity (Map 5 of Attachment B). This represents a reduction of over 10% of renewable energy, but would meet the overall project purpose by generating between 300MW and 750MW.

Cost: This alternative would allow for the generation of 709 MW at a cost of approximately $3,000 per kW considering the cost of constructing the common facilities and installing the SunCatchers. By increasing the cost per kW by $50, the construction costs for this project would increase by $35,400,000 as compared to the cost associated with the 750 MW proposed project. The estimated total construction cost for 709 MW is $2,127,000,000. Although, the costs for this alternative are $50/kW more than those used to negotiate the PPA with SDG&E, TSNA has determined that it is practicable to absorb this cost increase and provide electricity at the prices in the agreement. Although this alternative would result in substantial additional costs, it meets the cost screening criteria.

Logistical: This alternative allows for the installation of approximately 28,360 SunCatcher™ units that can efficiently be grouped into 360 SunCatcher™ groups, allowing for the efficient generation and transmission of electricity generated. It allows for the installation of perimeter, arterial, and maintenance roads necessary to service each of the SunCatcher groups and to meet necessary safety and security requirements. Utilities can be installed to serve each of the units and the main facilities complex can be located in the center of the project site. This alternative meets the logistical criteria.

Technology: Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: This alternative would result in permanent impacts to 38.2 acres and temporary impacts to 14.0 acres of WUS (Table 7).

Table 7. Permanent and temporary impacts to waters of the U.S. associated with Alternative #3.

		Permanent		Temporary	
Impacts		Primary	Secondary	Primary	Secondary
Roads	Arterial Roads	7.4	2.7	0.0	0.0
	Perimeter Roads	2.0	0.5	0.0	0.0
	Maintenance Roads	15.2	9.2	0.0	0.0
	Temporary Road	0.03	0.2	0.0	0.0
Waterline		0.0	0.0	0.0	0.0
Main Services Complex		0.01	0.7	0.0	0.0
SunCatchers (2 ft diameter)[1]		0.2	0.1	0.0	0.0
Perimeter Fence[2]		0.1	0.03	0.0	0.0
Electrical and Hydrogen Trenches[3]		0.0	0.0	8.6	5.4
Total		**24.9**	**13.3**	**8.6**	**5.4**

[1] – Impacts for the SunCatcher pedestals were calculated at 8.86×10^{-5} acres (4 square feet) per pedestal (3,214 pedestals total).
[2] – Temporary impacts associated with the electrical and hydrogen trenches necessary to each SunCatcher were calculated using a 12 inch wide trench for the hydrogen trench and a 24 inch wide trench for the electrical trench and 58 feet of trenching for each SunCatcher.

Conclusion: This alternative is practicable and has fewer impacts than the 900 and 750MW alternatives.

2.6.4 Alternative #4 - 300 MW Alternative

Overall Project Purpose: This alternative would allow for the generation of 300 MW of utility grade electricity (Map 6 of Attachment B). This alternative would meet the overall project purpose by generating between 300MW and 750MW

Cost: This alternative would allow for the generation of 300 MW at a cost of approximately $3,200 per kW. By increasing the cost per kW by $250 over the proposed project, the construction cost of this alternative would increase by $75,000,000, as compared to the cost building 300 MW with the costs associated with the 750 MW proposed project. The estimated total construction cost for 300 MW is $906,000,000. Construction costs for this alternative are substantially higher than those used to negotiate the PPA with SDG&E and exceed the cost threshold determined by prices in that agreement. This alternative does not meet the cost criteria.

Logistical: This alternative allows for the installation of 12,000 SunCatcher units that can efficiently be grouped into 360 SunCatcher™ groups, allowing for the efficient generation and transmission of electricity generated. It allows for the installation of perimeter, arterial and maintenance roads necessary to service each of the SunCatcher™ groups and to meet necessary safety and security requirements. Utilities can be installed to serve each of the units, but the main facilities complex would be located at one end of the project site, not providing the most efficient location for common facilities. This alternative meets the logistical criteria.

Technology: Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: This alternative would result in permanent impact to 27 acres and temporary impacts to 7.3 acres of WUS (Table 8).

Table 8. Permanent and temporary impacts to waters of the U.S. associated with Alternative #4.

Impacts		Permanent (Acres)		Temporary (Acres)	
		Primary	Secondary	Primary	Secondary
Roads	Arterial	1.2	1.1	0.0	0.0
	Perimeter	0.1	0.0	0.0	0.0
	Maintenance	2.0	4.5	0.0	0.0
Debris Basins		0.0	0.0	0.0	0.0
Water Line		0.0	0.0	4.4	0.2
Main Services Complex		7.1	10.9	0.0	0.0
SunCatchers (2 ft diameter)[1]		0.0	0.1	0.0	0.0
Electrical and Hydrogen Trenches[2]		0.0	0.0	1.2	1.5
Total		10.5	16.5	5.6	1.7

[1] – Impacts for the SunCatcher pedestals were calculated at 8.86×10^{-5} acres (4 square feet) per pedestal (983 pedestals total).
[2] – Temporary impacts associated with the electrical and hydrogen trenches necessary to each SunCatcher were calculated using a 6 inch wide trench for the hydrogen trench and a 24 inch wide trench for the electrical trench and 58 feet of trenching for each SunCatcher.

Conclusion: The 300MW Alternative does not meet the cost criteria. Therefore it is not practicable.

2.6.5 Alternative #5 - Drainage Avoidance #1 Alternative

Overall Project Purpose: This alternative would allow for the generation of up to 606 MW of utility grade electricity (Map 7 of Attachment B). This represents a reduction in 19% of the renewable energy, but meets the overall project purpose of generating between 300MW and 750MW. It should be noted that actual generation capacity of this alternative may be significantly less than described as this alternative was not based on an engineered design.

Cost: This alternative would allow for the generation of 606 MW at a cost of approximately $3,050 per kW. By increasing the cost per kW by $100 over the proposed project, the construction cost for this alternative would increase by $60,600,000 as compared to building 606 MW at the costs for the 750 MW proposed project. The estimated total construction cost for 606 MW is $1,848,300,000. Construction costs for this alternative are substantially higher than those used to negotiate the PPA with SDG&E and exceed the cost threshold determined by prices in that agreement. This alternative does not meet the cost criteria.

Logistics: This alternative allows for the installation of 25,200 SunCatcher™ units grouped into 360 SunCatcher™ groups. This alternative was developed as an alternative to avoid/minimize impacts to WUS and was not developed in consideration of the applicant's engineering logistical constraints. This alternative would result in multiple areas of isolated SunCatcher groups. Several examples are between Wash K and Wash A; the northern forked portion of Wash D; southern portions of Wash G; areas north of Wash E and other smaller areas where SunCatcher groups would be isolated. The Applicant would not construct SunCatcher groups in these isolated areas (refer to Logistics Criteria above). As such, this alternative would generate significantly less than the 607 MW estimated when this alternative was developed. Further, this alternative would require more than 50% of the generation groups to be non-standard configurations. This alternative does not meet the logistical criteria.

Technology: Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: This alternative would result in 38 acres of permanent impacts and 12.5 temporary impacts to WUS (Table 9).

Table 9. Permanent and temporary impacts to waters of the U.S. associated with Alternative #5.

Impacts		Permanent (Acres)		Temporary (Acres)	
		Primary	Secondary	Primary	Secondary
Roads	Arterial	6.1	2.8	0.0	0.0
	Perimeter	1.7	0.3	0.0	0.0
	Maintenance	0.0	9.0	0.0	0.0
Debris Basins		0.0	0.0	0.0	0.0
SunCatchers (2 ft diameter)[1]		0.0	0.1	0.0	0.0
Water Line		0.0	0.0	4.4	0.2
Main Services Complex		7.1	10.9	0.0	0.0
Electrical and Hydrogen Trenches[2]		0.0	0.0	0.0	7.9
Total		14.9	23.1	4.4	8.1

[1] – Impacts for the SunCatcher pedestals were calculated at 8.86×10^{-5} acres (4 square feet) per pedestal (1,218 pedestals total).
[2] – Temporary impacts associated with the electrical and hydrogen trenches necessary to each SunCatcher were calculated using a 6 inch wide trench for the hydrogen trench and a 24 inch wide trench for the electrical trench and 58 feet of trenching for each SunCatcher.

Conclusion: This alternative is not practicable as it does not meet cost or logistical screening criteria.

2.6.6 Alternative #6 - Drainage Avoidance #2 Alternative

Overall Project Purpose: This alternative would allow for the generation of 438 MW of utility grade electricity (Map 6 of Attachment B). This represents a reduction in 42% of the renewable energy available to SDG&, but meets with the overall project purpose of generating between 300MW and 750MW. While not an engineered design, the generation capacity of this alternative is considered by the applicant to be a reasonable estimate.

Cost: This alternative would allow for the generation of 438 MW at a cost of approximately $3,200 per kW. By increasing the cost per kW by $250 over the proposed project, the construction cost for this alternative would increase by $109,500,000 as compared to the cost of building 438 MW with the costs associated with the 750 MW proposed project. The estimated total construction cost for 438 MW is $1,401,600,000. Construction costs for this alternative are substantially higher than those used to negotiate the PPA with SDG&E and exceed the cost threshold determined by prices in that agreement. This alternative does not meet the cost criteria.

Logistics: This alternative allows for the installation of 15,960 SunCatcher™ units grouped into 266 SunCatcher™ groups. This alternative was developed as an alternative to avoid/minimize impacts to WUS and was not developed in consideration of the applicant's engineering logistical constraints. While an overall smaller facility, it allows for the efficient generation and transmission of electricity generated. It allows for the installation of perimeter, arterial and maintenance roads necessary to service each of the SunCatcher™ groups and to meet necessary safety and security requirements. Utilities can be installed to serve each of the units, but the main facilities complex would be located at one end of the project site, not providing the most efficient location for common facilities. This alternative meets the logistics criteria.

Technology: Existing Technology was determined by the Corps to have no bearing on the practicability analysis because all alternatives analyzed propose use of the same solar technology (e.g. Stirling Energy SunCatchers).

Environmental: This alternative would result in 31.9 acres of permanent impacts and 10.4 acres of temporary impacts to WUS (Table 10).

Table 10. Permanent and temporary impacts to waters of the U.S. associated with Alternative #6.

Impacts		Permanent (Acres)		Temporary (Acres)	
		Primary	Secondary	Primary	Secondary
Roads	Arterial	2.7	1.8	0.0	0.0
	Perimeter	1.1	0.0	0.0	0.0
	Maintenance	6.8	6.1	0.0	0.0
Debris Basins		0.0	0.0	0.0	0.0
SunCatchers (2 ft diameter)[1]		0.1	0.1	0.0	0.0
Water Line		0.0	0.0	4.4	0.2
Main Services Complex		7.1	10.9	0.0	0.0
Electrical and Hydrogen Trenches[2]		0.0	0.0	3.7	2.1
Total		17.8	14.1	8.1	2.3

[1] – Impacts for the SunCatcher pedestals were calculated at 8.86 x 10^{-5} acres (4 square feet) per pedestal (1,550 pedestals total).
[2] – Temporary impacts associated with the electrical and hydrogen trenches necessary to each SunCatcher were calculated using a 6 inch wide trench for the hydrogen trench and a 24 inch wide trench for the electrical trench and 58 feet of trenching for each SunCatcher.

Conclusion: This alternative is not practicable as it does not meet the cost screen criteria.

2.7 Summary of Environmental Impacts

This section provides a summary of environmental impacts for the three onsite alternatives that meet the practicability criteria (Alternatives 1, 2, and 3 [See Table 4]). Alternatives 1 and 2 would have greater impacts to WUS, two federally listed species (FTHL and PBS), and Alternative 2 would have greater impacts to sensitive cultural resources. These two alternatives were eliminated from further analysis and only Alternative 3 is continued through the detailed impacts analysis (sections 3, 4, and 5).

2.7.1 Alternative 1 Environmental Impacts Summary

The Alternative 1 meets the practicability criteria as stated above; however, it would have a larger environmental footprint when compared to the Alternative 3. The 750 MW Alternative would permanently impact approximately 177 acres of WUS compared to 38.2 for the 709 MW alternative (Table 4). No drainages would be avoided as in the Alternative 3 which would effectively eliminate any pathways for FTHL and other wildlife to traverse the project area. In addition, the additional impacts to WUS would further reduce desert wash habitat available for FTHL and general wildlife use. Due to the increased environmental impacts to WUS, FTHL, PBS, and general wildlife habitat, Alternative 1 is eliminated from further analysis.

2.7.2 Alternative 2 Environmental Impacts Summary

The Alternative 2 meets the practicability criteria as stated above; however, it would have a larger environmental footprint when compared to Alternative 3. In addition, the area between the eastern boundary of the proposed project area and Dunaway Road is an important cultural resource area that would be impacted with the construction of Alternative 2. A formal delineation has not been completed for the additional area included in the 900 MW Alternative, but it is estimated that the Alternative would permanently impact up to 205 acres of WUS which is five times greater than the Alternative 3. Similar impacts are expected, but the scale of the impacts would be increased for the Alternative 2. No drainages would be avoided as in the Alternative 3 which would inhibit FTHL and other wildlife from traversing the project area. In addition, a greater amount of potential forage for the PBS would be removed.

During the Applicant's initial cultural resources analysis, field surveys, and mapping exercises, a large number of cultural resources, including lithic surface finds, were concentrated between the current eastern boundary and Dunaway Road (CEC 2010). The 900 MW Alternative would impact these sensitive cultural sites and increase the overall cultural impacts compared to the other Alternatives. Due to the increased cultural resources impacts and increased impacts to WUS, the Alternative 2 is eliminated from further analysis.

2.7.3 Alternative 3 Environmental Impacts Summary

Alternative 3 incorporates several avoidance and mitigation measures as outlined in Section 2.5 to minimize impacts to WUS and associated wildlife. This alternative would reduce impacts to WUS by 78% (38.2 acres of permanent impact vs. 177 acres for Alternative 1). It would also eliminate the installation of SunCatchers in washes H, I, K, C, and the southern sections of washes E and G. This would allow for FTHL movement through the project area from the Yuha Desert FTHL Management Area to the south to the West Mesa FTHL Management Area to the north. In addition, the Alternative includes 200 foot corridors in the northern sections of Washes E and G to provide FTHL movement corridors on the eastern portion of the project area (Map 5 in Attachment B). Compared with Alternative 1, Alternative 3 would clear approximately 35 less acres of vegetation providing more forage to PBS in the area and protecting a greater proportion of the desert wash habitat within the project area. Alternative 3 would greatly reduce impacts to WUS, FTHL habitat, and PBS foraging habitat within the project area and Sections 3.0 and 4.0 describe the environmental impacts of this alternative with greater detail. Proposed mitigation for the unavoidable 38.2 acres is described in Section 5.0.

3.0 Existing Conditions

This section describes the baseline conditions on the proposed project area. It includes a description of the ephemeral streambeds located within the project area including the physical, chemical, and biological characteristics. Portions of the descriptions were taken or updated from the SA/DEIS. This information will continue to be updated as species information or analyses are completed by the applicant and/or the responsible regulatory agencies.

3.1 Location and General Description

The project site lies within the Imperial Subregion of the Colorado River Regional Water Quality Control Board (RWQCB). There are no perennial or intermittent streams on the project site. The closest perennial water feature is the West Side Main Canal, located east of the project site by approximately 3 miles. The closest natural perennial drainage to the project site is the New River, created in the early 1900's when the Colorado River overflowed a dike, and with the Alamo River further east, flowed through the Imperial Valley to form the Salton Sea. Both the New and Alamo Rivers flow from Mexico north to the Salton Sea collecting discharge from Mexican factories, Mexican sewage, and inflow from large and small irrigation canals that feed and drain the agriculture in the Imperial Valley. Subsequently, the New River is highly polluted as described in detail later in this section.

The ephemeral streams on the project site have been categorized as "primary" or "secondary" for the purposes of developing and analyzing project alternatives. The categorization is further described in the next section, but generally "primary" streams are main-stem streams originating south of the project site with a minimum Strahler order of 3 or higher and tributary streams that originate on-site with a Strahler order of 1 or 2 (Strahler 1957). Ten (10) primary ephemeral streams traverse the proposed IVSP site from south to north in the western portion of the site and from south to northeast in the eastern half of the site. Headwaters for these streams originate from gently sloping upland areas south and west of the property in the Yuma Desert. Culverts under the I-8 Freeway allow flows from primary streams south of the freeway to flow across and into the site. Some large secondary streams (i.e., C-5) that have large watersheds south of the interstate have been effectively intercepted by the interstate and as a consequence had their flows diverted by Caltrans to the culverts feeding the primary streams (Map 1 in Attachment B).

Ephemeral streams in the project area provide beneficial functions and services typical of high quality, low disturbance desert scrub systems. Riverine functions are generally categorized into hydrologic, physical, and biologic. Functions performed include, but are not limited to, groundwater recharge, flood peak attenuation, floodwater storage, sediment trapping and transport, nutrient trapping, and maintenance of wildlife corridors and habitat. These functions could be impaired to varying degrees by construction and operation of the proposed IVSP.

3.1.1 Jurisdictional Determination

Jurisdictional WUS were defined using a combination of the preliminary jurisdictional delineation report and map prepared by URS (2009), limited field verification by the Corps, CDFG, CEC, and BLM on November 10, 2009, review of high resolution aerial photography, hydrological information provided in the October 2009 Revision 1 version of the "Hydrologic Assessment Report IVSP Site" by RMT (2009), and personal communication with Imperial Irrigation District (IID) (January 7 and August 17, 2009). As stated previously, the streams on the site were categorized as "primary" or "secondary" streams (essentially equivalent to main-stem and tributary streams) based upon their size, the acreage of the watershed upstream of the drainage, and whether the drainage originates on-site. A total of 637 acres of primary streams and 244 acres of secondary streams were mapped (Table 11) and shown in Map 1 in Attachment B.

Table 11. Corps Jurisdictional Waters of the U.S.

Drainage ID	Area (acres)	Length (feet)	Drainage ID	Area (acres)	Length (feet)
I	24	7,106.5	E	199	26,150.5
J	11	4,159.5	E1	22	12,954.5
K	37	7.079.5	E2	2	2,146.7
K1	5	2,930.0	E3	3	2,549.1
K2	3	1,095.8	E4	2	1,905.7
A	25	7,209.2	E5	8	5,479.7
B	10	7,780.2	F	104	10,249.5
C	40	9,477.9	F1	12	7,827.6
C1	12	5,666.3	F2	5	2,645.1
C2	10	8,038.9	F3	7	3,697.7
C3	13	7,922.8	G	115	20,849.3
C4	7	5,222.5	G1	18	6,564.5
C5	2	1,279.0	G2	9	4,382.3
D	75	17,869.5	G3	10	4,163.6
D1	27	11,155.7	H	7	959.8
D2	29	14,883.6	SI	22	6,371.9
D3	6	3,051.7			
Total Drainage Length: 240,826 feet Total Drainage Acreage: 881 acres					

Most of the primary streams on the project area are compound ephemeral channels. Compound ephemeral channels (Lichvar et al. 2009; Lichvar and McColley 2008) are characterized by a mosaic of terraces within a wide, active floodplain by a single, low-flow meandering channel inset into a wider braided channel network and mosaic of terraces (Graf 1988a). These channels are highly susceptible to widening and avulsions (channel relocation) during moderate to high discharges, reestablishing a low-flow channel during subsequent low flows (Lichvar et al. 2009; Lichvar and McColley 2008).

A high density of closely spaced braided channels with high width-to-depth ratio and low sinuosity generally characterize the larger streams on the study site. High width-to-depth ratios, braided channels and low sinuosity are often the result of high sediment concentrations and coarse grain sizes (Bull and Kirkby 2002).

Some of the secondary streams on the project site are discontinuous ephemeral streams (Lichvar et al. 2009; Lichvar and McColley 2008), characterized by alternating erosional and depositional reaches. They are constantly in flux, as headcuts (knick points) originating at the downstream end of the sheet flood zone migrate upstream, causing dramatic temporal and spatial changes in channel morphology for any given location. Headwater streams on the site are characterized by some gullying and "badland" development. Most of the channels on the project site appear to have deep sediments composed of sands and gravels, with widely scattered vegetation growing within the channel and its floodplain.

3.1.2 Condition of Ephemeral Streams

Southern California Coastal Water Research Project (SCCWRP) was contracted by TSNA at the recommendation of the Corps in order to evaluate the baseline condition of the desert streams on the project site utilizing the California Rapid Assessment Method (CRAM; SCCWRP, May 2010, Attachment D). The State and Federal agencies that comprise the California Wetlands Monitoring Workgroup (CWMW)[2] are promoting the use of rapid assessment methods (RAMs) as a core tool to evaluate aquatic resource condition. Currently, CRAM is the most widely used wetland rapid assessment in the State (www.cramwetlands.org). CRAM is intended to provide a rapid and repeatable assessment method that can be used routinely for wetland monitoring and assessment throughout the State of California. It provides consistent and comparable assessments of wetland condition for all wetlands and regions in California, yet accommodates special characteristics of different regions and types of wetlands. The CRAM typology currently recognizes six major wetland types, four of which have subtypes (Attachment D, Table 1). For the purposes of CRAM, *condition* is defined as the state of a wetland assessment area's physical and biological structure, the hydrology, and its buffer and landscape context relative to the best achievable states for the same type of wetland. Condition is evaluated based on observations made at the time of the assessment, the results of which can be used to infer the ability to provide various functions, services, values and beneficial uses to which a wetland is most suited (Collins et al. 2007), although these are not measured directly by CRAM. CRAM also identifies key anthropogenic stressors that may be affecting wetland condition.

In April 2008, the Corps, together with the EPA issued new national regulations, also known as the "Mitigation Rule," governing compensatory mitigation for activities authorized by permits issued by the Department of the Army (33 CFR Parts 325 and 332 [40 CFR Part 230]). The

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[2] The CWMW is a subcommittee of the California Water Quality Monitoring Council (Senate Bill 1070; Kehoe, 2006),

Corps LA District is in the process of updating the Mitigation and Monitoring Guidelines (Guidelines) to comply with the Mitigation Rule. The Mitigation Rule emphasizes the watershed approach and functional assessment methodology in evaluating project impacts and mitigation strategies. The use of CRAM in the context of the IVSP is used to first understand the baseline condition of the desert streams on the project site described in this section, estimate direct impacts and indirect impacts post-project described in section 4.3.1, and evaluate the adequacy of the proposed mitigation in section 5.0. In addition, this CRAM analysis is the first phase of a long-term research effort to refine, modify, and validate the Riverine CRAM for application to ephemeral streams in desert regions of California.

A total of 84 stream sites or Assessment Areas (AA) within the study site was assessed with CRAM (Appendix 4; Appendix 5a-b of the CRAM report [Attachment D]). None of the sites contained flowing surface water at the time of the CRAM assessment. All sites were classified as unconfined riverine systems (i.e., the width of the valley across which the system can migrate without encountering a hillside, terrace, or other feature that is likely to prevent further migration is at least twice the average bankfull width of the channel).

Overall CRAM index scores for these sites ranged from 53 to 80 (SCCWRP; Attachment D). AA 154 (C-44) received the highest overall index score and AA 356 (E-105), 269 (E-86), and 124 (B-35) were the three lowest scoring sites in the study area (Appendix 1 of the CRAM Report). Based on the known precision for overall index scores, AA scores that differ by 11 CRAM points or greater should be considered to represent differences in overall condition. For example, AA 154 (C-44), with an Overall Index Score of 80, can be interpreted as having higher ecological condition than AA 103 (A-30), which received a score of 67. However, AA 53 (G-19) and AA 57 (G-21), which received overall index scores of 79 and 72, respectively, do not represent significant differences in overall condition. A similar interpretation can be made for Attribute scores. Two scores for the same Attribute that differ by less than 5 CRAM points should not be regarded as representing differences in condition. Table 12 lists the distribution of metric and submetric scores (A-D) for all sites combined.

Table 12. Summary statistics of CRAM scores from the study site.

CRAM Index and Attributes	Mean	SE	SD	Median	Maximum	Minimum
Overall Index Score	68	1	6	69	80	53
Landscape Context	95	1	9	100	100	48
Hydrology	91	1	5	92	100	67
Physical Structure	41	1	13	50	75	25
Biotic Structure	46	1	9	44	75	31

It was noted at the beginning of the CRAM analysis that the current CRAM Riverine module would have limited applicability to the arid, ephemeral streams found on the project site due to the lack of species rich plant communities with vertical and horizontal structure complexity. The CRAM Riverine module was originally designed for the coastal Riverine systems that typically have greater plant diversity and cover and greater ecological complexity. The results of the CRAM analysis indicate that the CRAM Riverine module can be applied to arid, ephemeral streams but some of the metrics will need to be recalibrated. The Landscape and Buffer Attribute appeared adequate as currently constructed while the Hydrology Attribute performed reasonably well, but some of the current metrics will need to be revised. The Biological and Physical Attributes were problematic when applied to the ephemeral streams on site due to the lack of physical and biological complexity. When compared to CRAM scores for perennial, coastal streams, scores for the project area were consistently lower for the Physical and Biological Attributes since these attributes of the CRAM Riverine module were designed to detect complexity within a system (Collins et al).

No dramatic spatial trends in drainage condition scores were evident on the study site (Table 13 and Appendix 6 of the CRAM report [Attachment D]). Some assessments areas located near the perimeter of the study site tended to score lower than sites located near its center. These sites scored lower because of their proximity to I-8 to the south, and Evan Hewes Highway, the raised railroad bed, and the Plaster City industrial Complex to the north. These structures affected the Buffer and Landscape Connectivity Attribute; there were greater infestations of noxious weeds along the perimeter of the site, and there were signs of abnormal aggradations (near the raised railroad bed) and degradation (near where the culverts discharged under I-8).

No primary drainage differs from another by at least 11 points, so no differences in overall score can be assessed. For individual attributes, six CRAM points denote a difference in the condition of that attribute. The CRAM scores show some significant fluctuations for Physical and Biotic Structure. Primary streams A, F, B, and I had the lowest scores for Physical Structure and primary streams C, G, and H had the highest Physical Structure scores. Likewise, differences were observed in the biotic structure with streams B, E, and K having the lowest scores and D, F, and H having the highest scores (Table 13).

Table 13. CRAM scores for each primary drainage.

Primary Streams	Number of Stream Sites	Overall Index Score	Landscape Context	Hydrology	Physical Structure	Biotic Structure
A	3	64.0	90.4	91.7	25.0	49.1
B	5	64.0	94.8	88.3	35.0	37.8
C	4	71.6	98.3	87.5	50.0	50.7
D	4	72.7	100.0	93.8	43.8	53.5
E	6	64.0	88.0	88.9	37.5	41.7
F	2	68.1	100.0	91.7	25.0	55.6
G	9	70.4	93.3	89.8	48.6	49.7
H	1	75.2	84.0	91.7	50.0	75.0
I	2	63.8	83.1	87.5	37.5	47.2
K	4	68.3	96.3	91.7	40.6	44.4

Similar to the primary streams, none of the combined secondary streams had overall scores that differed by greater than 10 CRAM points. As with the primary streams, there were some fluctuations with the Physical Structure and Biotic Structure with scores ranging from 33 to 50 for Physical Structure and 39 to 56 for Biotic Structure (Table 14).

Table 14. CRAM scores for the combined secondary streams.

Secondary Streams	Number of Stream Sites	Overall Index Score	Landscape Context	Hydrology	Physical Structure	Biotic Structure
C	8	67.87	95.49	90.00	40.42	45.56
D	10	70.82	99.71	94.17	44.38	45.05
E	8	72.61	97.66	91.67	50.00	51.11
F	5	67.59	100.00	92.59	33.33	44.44
G	3	66.46	97.77	91.67	37.50	38.89
J	1	62.91	80.80	91.67	37.50	41.67
K	1	69.44	100.00	75.00	50.00	52.78
S	1	74.31	100.00	91.67	50.00	55.56

3.1.2.1 Buffer and Landscape Context

Because this attribute of CRAM addresses general landscape aspects of the riparian vegetation and buffer of a site, the metrics as scored with the Riverine Module are generally applicable to sites within the study area. Although the existing riparian vegetation on the study site may differ in complexity, structure, and species composition from more mesic riparian systems, the connectivity of the riparian corridor and buffer of arid, ephemeral streams still provide important structural habitat for a variety of wildlife species, play an important role in the dispersal of both animals and plants, and also shade and stabilize fluvial environments, providing habitat for aquatic organisms (Naiman et al. 1993, Patten 1998).

For riverine CRAM, this attribute is scored with two metrics: (1) the continuity of the riparian corridor over a prescribed distance upstream and downstream of the assessment area, and (2) the amount, size, and condition of the buffer on both sides of the assessment area. Final condition scores for the Landscape and Buffer Context attribute ranged from 48-100 (μ= 95, σ= 9; Table 12). Overall, this was the highest scoring CRAM attribute, with 67% of sites assessed receiving a score of 100 (the highest obtainable for this attribute). These sites were located primarily in the center of the project area where there is little development. The remaining 33 percent of sites were located on the perimeter of the site where I-8 to the south, and Evan Hewes Highway, the raised railroad bed, and the Plaster City industrial complex to the north, interrupted the landscape connectivity metric and buffer which lowered the scores.

3.1.2.2 Hydrology

For riverine CRAM, this attribute is scored with three metrics: (1) Water Source (direct fresh water sources to the channel during the dry season), (2) Channel Stability (the degree of channel aggradation or degradation), and (3) Hydrologic Connectivity (assessed based on the degree of channel entrenchment, calculated as the flood-prone width divided by the bank full width; Leopold *et al*. 1964, Rosgen 1996, Montgomery and MacDonald 2002). These metrics are discussed in detail in the attached CRAM report (Attachment 3). Final scores for the Hydrology attribute ranged from 67-100 (μ= 91, σ= 5; Table 12). Overall, this CRAM attribute scored relatively high, with 86% of sites assessed receiving a final score of 92 or greater. Metrics of the Hydrology attribute in CRAM assess the sources, quantities, and movements of water, plus the quantities, transport, and fates of water-borne materials, particularly sediment as bed load and suspended load (Collins et al. 2008).

Overall, channel stability within the project area can be characterized as generally being in equilibrium with minor signs of aggradation which is expected for normally functioning arid, ephemeral streams. Signs of incision/downcutting were observed just downstream of where culverts discharged under I-8. The culverts focused flow from the upstream side of I-8 resulting in greater, narrower flows downstream of the culverts until the energy dissipated. Signs of excess aggradation were observed west of Plaster City where streams were diverted by the raised railroad bed to an underpass. Sediment was dropped out of the water column where the streams were diverted and flow was impeded.

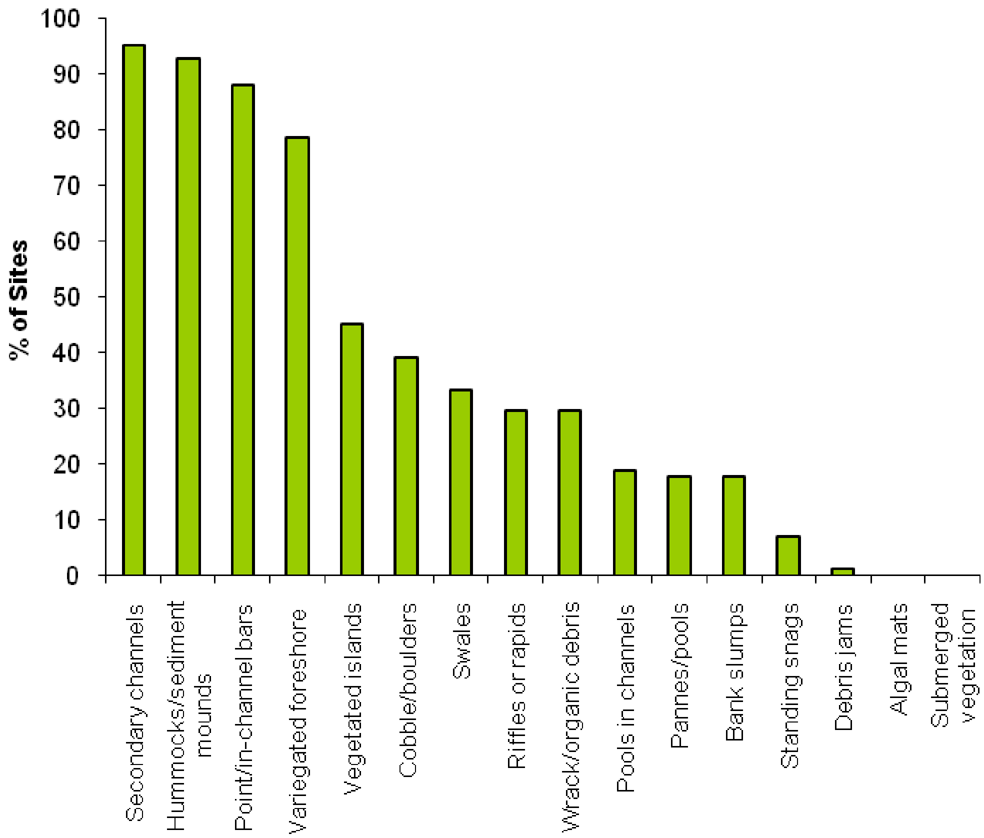
Hydrologic Connectivity is assessed based on the degree of channel entrenchment, or the inability of flows in a channel to exceed the channel banks. Where an entrenchment ratio was measured, (93%) scored an "A(12)" for this metric, indicating that channels are not entrenched (mean entrenchment ratio for sites was 6.6 m). Although most sites assessed in the study area scored high for this metric (i.e., channels were generally not entrenched), the conceptual model and field techniques used to assess this metric in the field under the current CRAM Riverine Module will require reevaluation for aridland streams.

3.1.2.3 Physical Structure

The metrics used to score the Physical Structure Attribute of CRAM (physical patch types and topographic complexity) generally scored very low for the ephemeral streams assessed on the study site. Overall, this attribute did not apply well as constructed to the arid, ephemeral streams found on the project site. For CRAM, this attribute is scored with two metrics: (1) Patch Richness (the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species) and (2) Topographic Complexity (the spatial arrangement and interspersion of patch types). A detailed discussion of the two metrics is provided in the CRAM report (Attachment D). Final scores for the Physical Structure attribute ranged from 25-75 (μ= 41, σ= 13; Table 12). Overall, this was the lowest scoring CRAM attribute, with 30% of sites assessed receiving a final score of 25 (the lowest possible for this metric).

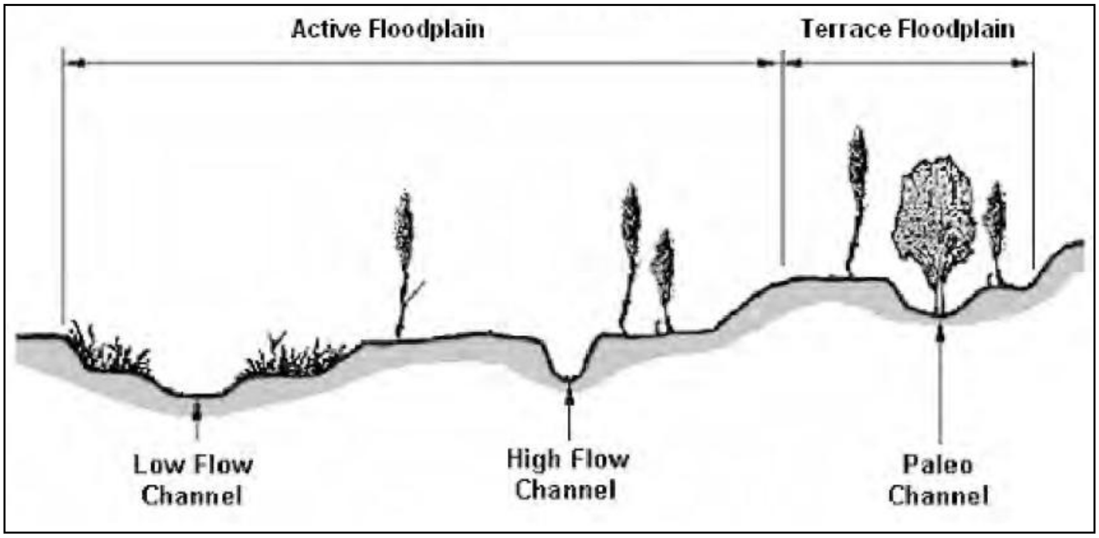
For the physical patch type richness metric, most sites scored low due to the few patch types observed in the field. This is somewhat misleading because some of the patch types listed in the current Riverine module would not occur within an arid system such as algae, submerged vegetation. Figure 6 shows the patch types that occurred within the project area. The first four patch types were found in over 75% of the stream sites while the remaining patch types were observed in less than 45% of the stream sites. There was no discernible trend for which sites scored higher than others.

Figure 6. Occurrence of patch types based on the percent of sites assessed in the study area.



To receive a high for the Topographic Complexity CRAM metric, the presence of two elevational changes (i.e., "benches" or breaks in channel slope) is required. In perennial streams, benching is facilitated by variations in flow and sediment regimes. Because arid land streams experience extreme and rapid variations in flood regime, the formation of benches is not a process that is expected to occur. Revised cross-section diagrams for arid stream systems would assist in interpretation of the topographic complexity metric, and potentially generate more variable scores for this metric. For example, in Figure 7, these cross-section diagrams could depict representations of in-channel features (e.g., low flow channel, active floodplain, and adjacent terraces) rather than elevation changes associated exclusively with the edge of the assessment area as was seen within the project area.

Figure 7. Typical arid, ephemeral/intermittent stream cross section and its associated hydrogeomorphic floodplain units (Lichvar et al. 2009).



3.1.3.4 Biological Structure

The metrics used to score the Biological Structure Attribute of CRAM (physical patch types and topographic complexity) generally scored very low for the ephemeral streams assessed on the study site. Overall, this attribute did not apply well as constructed to the arid, ephemeral streams found on the project site because the CRAM Riverine module uses complexity of plant communities and their position within the landscape to score this attribute. The arid, ephemeral streams of the project area are simple systems with few plant species, low plant cover, and low complexity across the landscape.

Metrics comprising this attribute focus on aspects of the vascular vegetation that contributes to a wetland's material structure and architecture. It is scored with three metrics: (1) Plant Community (number of vegetation layers, dominant plant species richness, and the number of invasive co-dominant species), (2) Horizontal Interspersion and Zonation (the number of distinct plant zones and the amount of edge between them), and (3) Vertical Biotic Structure (the degree of overlap among plant layers) and are discussed in greater detail in the CRAM Report (Attachment D). Final condition scores for the Biotic Structure attribute ranged from 53-80 (μ= 46, σ= 9; Table 12). Overall, this was the second lowest scoring CRAM attribute, with 73% of sites assessed receiving a final score of 47 or less.

In general, the sites near the northern perimeter of the site scored lower for the Plant Community Metric due to an increased presence of non-native species that decreased the scores for the metric. No sites scored high for the Horizontal Interspersion and Zonation and Vertical Biotic Structure metrics due to the simplistic nature of the plant communities that contain little to no horizontal and vertical overlap of plant communities.

3.2 Physical and Chemical Characteristics

3.2.1 Physical Substrate Determinations

Soil map units on the proposed project site primarily correspond to the Rositas, Carrizo, and Orita soil series, as classified by the United States Department of Agriculture (USDA) in *Soil Survey of Imperial County California Imperial Valley Area* (USDA, Soil Conservation Service [SCS] 1981) and *Web Soil Survey* (USDA, Natural Resources Conservation Service [NRCS] 2010). Soil map units in the eastern 300 acres of Phase II, the laydown area, and portions of the proposed water line correspond to the Meloland, Vint, and Indio soil series or the Imperial, Glenbar, and Gilman soil series. A small area, consisting of soil map units that correspond to the Badland miscellaneous land type and Beeline and Rillito soil series, occurs along the alignment for the proposed transmission line.

The Rositas, Carrizo, and Orita soil series consist of sands to gravelly loams that typically formed on alluvial fans, floodplains and alluvial basin floors. These soils are extremely to highly erodible, and exhibit high permeability and potential for wind erosion. Erosion factors are used to predict the erodability of a soil and its tolerance to erosion related to specific land uses and treatments. The soil erosion factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible, with values ranging from 0.10 to 0.64. To estimate the annual soil loss per acre, the K value is modified by site-specific and/or regional parameters that include vegetative cover, grade and length of slope, management practices, and climate. The K value is relatively low for these soils at 0.20, which generally indicates a low potential for erosion-related annual soil loss per acre. However, since K also factors in climate as a modifier and total precipitation is very low in the region, a low K value does not necessarily indicate that these soils are resistant to erosion during precipitation events.

The Meloland, Vint, and Indio soil series consist of sands, sandy loams, or silty loams that formed in recent mixed alluvium on floodplains, and alluvial basin floors. These soils are highly erodible to erodible, and exhibit moderate permeability and potential for wind erosion. The K value is generally moderate to high for these soils (~0.40, but up to 0.55), which suggests these soils have a higher potential for erosion-related annual soil loss per acre than the above soil series.

The Imperial, Glenbar, and Gilman soil series are included among the highly productive farmland soils located in the agricultural area of Imperial County. These soils are erodible to moderately erodible, and exhibit low permeability and potential for wind erosion. The K value is moderate for these soils (~0.40), indicating these soils have a moderate potential for erosion-related annual soil loss per acre.

The Badland miscellaneous land type consists of barren land on unconsolidated, stratified alluvium, and generally includes clays to gravelly sands in steep to very steep barren lands that are dissected by streams. This land type is extremely erodible, with surface runoff that is rapid or very rapid and the hazard of erosion is high. However, the K value is low for this miscellaneous land type at 0.10, which implies a low potential for erosion-related annual soil loss per acre. As previously discussed, the K value factors in climate as a modifier and total precipitation is very low in the region; therefore, a low K value does not always indicate soil resistance to erosion during flood events.

The Beeline soil series consists of shallow and very shallow, well-drained sandy loams that formed in mixed alluvium, and typically occur on fan terraces and hill slopes. Beeline soils are well-drained with medium to rapid runoff and moderately rapid permeability. The Rillito soil series consists of very deep, somewhat excessively drained sandy loams that formed in mixed alluvium that are found on fan terraces or stream terraces. Rillito soils are somewhat excessively drained, and exhibit slow or medium runoff and moderate permeability.

3.2.2 Water Circulation, Fluctuation, and Salinity Determinations

As presented in Section 3.1, no perennial or intermittent streams are present within the proposed project site, with the closest perennial drainage being the New River. Several ephemeral streams traverse the project site, generally conveying water from the south to north in the western portion of the site and toward the northeast in the eastern portion of the site (see Maps 1 and 2 in Attachment B).

The ephemeral streams on the site are normally dry. They convey water infrequently and only following precipitation events of intensities sufficient to result in flowing water. Rainfall is minimal in this region and long periods of time may pass between rain events. When it does occur, flowing water within the streams is generally activated by summer monsoons that produce short-duration, high-intensity flash flooding. According to Chang (2010a), a 100 year flood event would result in approximately a one foot depth of water flowing in project area streams. Winter storms typically result in greater rainfall totals on average than the summer monsoons, but they are widespread, low-intensity events that result in little runoff. For example, stream gage records for San Felipe Creek located approximately 20 miles north of the project site indicate that August and September flows are nearly five times higher than the December to February flows. Although the majority of the rainfall occurs during winter, the majority of annual runoff occurs during the summer months of July to September.

Figure 1 of the SA/DEIS Soil and Water Resources section shows the location, watershed areas, and estimated 100-year peak discharges of 12 streams entering the project site from the south. Stream flow estimates have been made for these watersheds using a rainfall/runoff model (SES, 2008a). This model uses rainfall estimates (2.62 inches over a 6-hour period for a 100-year event), soil type, and area and topographic information to estimate peak runoff. Watershed areas for the streams, shown in Figure 1 of the SA/DEIS Soil and Water Resources section, range from 58 to 1,574 acres, averaging 548 acres. The estimated 100-year discharges range from 57 cubic feet per second (cfs) to 777 cfs.

The 100-year discharge represents the discharge from a flood event with an annual probability of occurrence of 1%. Commonly called the 100-year flood, a flood of this magnitude is expected to occur, on average, once every 100 years. Since there is a 1% chance that this flood occurs every year, it is possible for more, or fewer, than one flood of this magnitude to occur in a 100-year period. The 100-year flood has been designated by the Federal Emergency Management Agency (FEMA) as the national regulatory flood for flood insurance and floodplain management purposes (See Map 2 in Attachment B).

As the ephemeral streams pass through the project site, some combine and form new watersheds. Figure 1 of the SA/DEIS Soil and Water Resources section shows the location, watershed areas, and 100-year peak discharges for ten watercourses exiting the site toward the north and east. Watersheds for these streams range from 147 to 18,856 acres in area, averaging 3,246 acres (median 1,274 acres). The 100-year discharge for these watersheds ranges from 126 cfs to 4,223 cfs.

Discharges for more frequent floods have also been determined. The 25-year peak discharges, with 4% chance of occurrence in any given year, are roughly 50% of the 100-year peaks given in Figure 1 of the DEIS *Soil and Water Resources* section. The 10-year discharges, with 10% chance of occurrence per year, are roughly 30% of the 100-year peaks. The 5-year discharges, with 20% chance of occurrence per year, are roughly 15% to 20% of the 100-year peaks. For instance, for concentration point “CS”, the estimated discharges are: 100-year = 777 cfs; 25-year = 397 cfs; 10-year = 217 cfs; and 5-year = 119 cfs.

Flows exiting the site on the north in the Phase I area are returned to the site at a point east of Plaster City, where they join other on-site flows in the Phase II area. All Phase II flows eventually exit the site on the east, overtop Dunaway Road, and drain toward the Westside Main Canal. This large drainage feature located south of Plaster City consolidates flows from much of the eastern portion of the property and is mapped as a FEMA floodplain. Flows of sufficient volume and discharge would be conveyed east to the Westside Main Canal, where IID has created a series of rough sediment detention basins to mitigate the effect of sediment discharge on water quantity and quality of the the irrigation canals . Nonetheless, IID has communicated to the Corps that regular overflows into the Westside Main Canal occur (personal communication, January 7 and August 17, 2009).). The Westside Main Canal flows north and at several locations can, in large events, confluence with the New River. Both the Westside Main Canal and the New River empty into the Salton Sea.

Flooding is considered to be that area of a channel or area adjacent to a channel that is subject to inundation by channel flows. Flooding can occur anywhere there is a natural drainage on the project site. The FEMA prepares 100-year flood maps for flood insurance purposes and for floodplain management use by local agencies. FEMA map panels 06025C-1650C and 06025C-1675C cover the project site. Two watercourses, corresponding to E2 to Dunaway and C North on Figure 1 of the SA/DEIS Soil and Water Resources section have been mapped by FEMA as Zone A, which means 100-year flood zone with no base flood levels determined. These are considered approximate flood zones. Figure 2 of the SA/DEIS Soil and Water Resources section shows the location of the FEMA-mapped floodplain on the project site (also shown in Map 2 of Attachment B).

FEMA maps do not cover all floodplains. Rural areas, such as the project site, are commonly not mapped. Independent floodplain mapping has been performed based on the discharges given in Figure 1 of the SA/DEIS Soil and Water Resources section. This flood mapping is shown in Figure 3 of the SA/DEIS Soil and Water Resources section and shows floodplains associated with 24 streams and one sink area (Basin D Lake) on the project site.

Salinity is expressed as the electrical conductivity of the soil saturation extract, in mmhos per centimeter (mmhos/cm) at 25 degrees Celsius. Salinity estimates for soil series types present on the site were derived by the USDA, SCS (1981) based on field and laboratory measurements of soils at representative sites in the Imperial Valley area. Results of these estimates indicated that: Glenbar, Indio, and Rositas soil series generally exhibited salinity levels of less than 4 mmhos/cm; Meloland and Vint soil series generally exhibited salinity levels of 2-8 mmhos/cm; and Imperial soil series generally exhibited salinity levels of 4-8 mmhos/cm.

3.2.3 Suspended Particulate/Turbidity Determinations

No perennial or intermittent streams are located within the project site, and no water quality data is available for the site. Water quality of surface runoff flows would be dependent on materials picked up on the ground surface, which is currently natural desert. The downstream disposition of surface runoff from the site is the desert area north of the project site in Coyote Wash and west of the Westside Main Canal, possibly the Westside Main Canal itself, local drainage and irrigation ditches west of the Westside Main Canal, the New River, and eventually the Salton Sea (See Maps 1 and 2 in Attachment B).

3.2.4 Contaminant Determinations

As previously stated, the downstream deposition of surface runoff from the site is the desert area west of the Westside Main Canal, possibly the Westside Main Canal itself, local drainage and irrigation ditches west of the Westside Main Canal, the New River, and eventually the Salton Sea.

The New River is considered highly polluted from agricultural runoff, sewage from Mexico, and discharges from manufacturing plants in Mexico, and is listed as impaired under Section 303(d) of the Clean Water Act for a wide range of pollutants including, but not limited to: trimethylbenzene, chlordane, chloroform, chlorpyifos, copper, DDT, diazinon, dieldrin, mercury, meta-para xylenes, nutrients, organic enrichment, pesticides, and selenium. The Salton Sea is listed as impaired for nutrients, salinity, and selenium.

The RWQCB identifies beneficial uses of waters in the State that may be protected against water quality degradation. These include such uses as domestic, municipal, agricultural, recreation, natural resources, and aesthetic enjoyment. Beneficial uses identified for streams in the west Colorado River basin (Colorado River Basin Regional Water Quality Control Board, 2006) include groundwater recharge, non-contact water recreation, and wildlife habitat.

Groundwater in the Coyote Wells Valley Groundwater Basin is type sodium bicarbonate-chloride. Total dissolved solids (TDS) content ranges from 750 to 1,240 milligram/liter (mg/L) in shallow wells to 300 to 450 mg/L in deeper wells (California Department of Water Resources, 1973). Fluoride levels in some wells are as high as 3.5 mg/L (California Department of Water Resources, 2003). Water quality in the Imperial Valley Groundwater Basin varies extensively throughout the basin. TDS content ranges from 498 to 7,280 mg/L in the basin. Department of Health Services data from five public supply wells show an average TDS concentration of 712 mg/L with a range from 662 to 817 mg/L. In general, groundwater beneath the basin is unusable for domestic and irrigation purposes without treatment. TDS values typically exceeding 2,000 mg/L are reported from a limited number of test wells drilled in the western part of the basin. Groundwater in areas of the basin has higher than recommended levels of fluoride and boron. Approximately 7,000-acre-feet per year of groundwater is estimated to recharge the basin from the New River which drains the Mexicali Valley. This groundwater is related to surface flow from the highly polluted New River and negatively affects groundwater quality in the basin (California Department of Water Resources, 2003).

3.3 Biological Characteristics

As described previously, ephemeral desert streams traverse the site from south to north and south to northeast conveying flows following a substantial rainfall. The vegetation community type of the streams, classified as Sonoran creosote bush scrub, also contain sparse and isolated stands of mesquite (SES 2008a). Within the streams several species supported that are indicative of surface and shallow surface flows and which do not occur in the uplands include burrobush (*Ambrosia dumosa*), big galleta (*Pleuraphis rigida*), button brittlebrush (*Encelia frutescens*), and Schott's dalea (*Psorothamnus schottii*). The ephemeral streams generally contain greater vegetative diversity and density than the creosote bush scrub habitat outside of the streams (SES 2009d). For the IVSP site, the CORPS jurisdictional WUS is approximately 881 acres. The condition of the desert streams was evaluated using the CRAM as summarized previously in Section 3.1.2.

During the CRAM effort, point intercept transects were used on certain plots to better classify the vegetation of the streams within the project area. Overall, the percent cover of plants was 28.0 percent, which is higher than the surrounding upland areas where there are wide areas that are almost barren. The numbers of species observed on primary streams were 6.8 native and 1.6 non-native species. For secondary streams, the average number of native and non-native species observed within a transect were 5.7 and 0.8 species, respectively.

The Co-Dominant Species submetric of CRAM is assessed as living vegetation that comprises at least 10% relative cover within each plant layer identified in the AA. To be classified as a plant layer, the cover in that height layer must be at least 5% total cover. Most stream sites assessed had short (< 0.5 m tall) and medium (0.5-1.5 m tall) layers with seven of 84 sites (eight percent) having a tall layer (1.5-3.0 me tall). The seven most common co-dominant native species were burrobush, six-week threeawn (*Aristida adscensionis*), button brittlebrush, creosote bush, big galleta, and Schott's dalea. Non-native species that were co-dominant in some stream sites are tumble mustard, Asian mustard, and common Mediterranean grass.

Primary streams on the project site originate in the Yuha Desert to the south and flow under I-8. The primary streams are typically wider with larger flows than the secondary streams. During the CRAM effort, measurements of Ordinary High Water Mark (OHWM) and width of the active floodplain were wider than the secondary streams. The average OHWM for the primary streams measured was 10.9 m and the average active floodplain width was 57.4 m. The average OHWM for the secondary streams was 7.3 m and the average active floodplain width was 28.2 m. In addition, the species composition of the primary streams differed from the secondary streams. The primary streams had 21.9% cover of plants compared with 34% cover for the secondary streams.

Off-site linear features, such as the reclaimed water pipeline, would either span the seven irrigation canals and the New River via attachment to bridge crossings or other structures or go under the waterbodies via directional boring. The canals and the New River are considered WUS (SES 2009c). Seepage from some of the canals has created adjacent wetlands with large stands of tamarisk scrub (*Tamarix* sp.) and arrow weed (*Pluchea sericea*) scrub, which are under federal jurisdiction. The estimated acreage of WUS is 2.33 acres (SES 2009c).

The SWWTF is located at 1898 West Main Street in Seeley, California, approximately 13 miles east of the project site. According to the Draft MND for the SWWTF upgrades (Dudek 2009), the SWWTF site supports developed/disturbed land with limited to no vegetative growth, and discharges up to 0.15 cfs of effluent to the New River through an unlined earthen channel that is approximately 800 feet long and 50 feet wide (0.92 acre). The approximately 0.92 acre channel supports narrow-leaved cattail (*Typha latifolia*), tamarisk, arrow weed, and Emory's baccharis (*Baccharis emoryi*), but because of its small size and fragmented character it was considered sub-optimal for breeding use by Yuma clapper rail and other riparian bird species (Dudek 2009). A vegetation map has been completed for the area around the SWWTF, including 500 feet upstream and downstream of the site on the New River. This map is included in the Seeley Environmental Review Update which is part of the EIS (Dudek 2010).

3.3.2 Threatened and Endangered Animals

One species proposed for listing as threatened and one federally listed endangered species have been detected on the project site. Flat-tailed horned lizard (*Phrynosoma mcallii*, FTHL) is proposed for listing as Threatened and Peninsular bighorn sheep (Distinct Population Segment of desert bighorn sheep: *Ovis canadensis nelsoni*, PBS) is federally listed as endangered. Designated Critical Habitat (DCH) for PBS exists approximately four miles west of the project site.

Another federally listed endangered species, the Yuma clapper rail (*Rallus longirostris yumanensis*), has potential habitat and known populations within 2 miles north of the SWWTF near where the New River empties into the Salton Sea, and one mile south in an area known as Fig Lagoon (Dudek 2010). Another state-listed bird, the California black rail (*Laterallus jamaicensis coturniculus*), had potential habitat in similar areas as the Yuma clapper rail. Surveys for the special status species in the vicinity of SWWTF have been negative. Endangered and threatened species and impacts associated with the Proposed Action and the various alternatives are discussed in detail in Section C.2 – Biological Resources of the SSA and in Section 4.3 of the Final EIS. Formal Section 7 consultation with the United States Fish and Wildlife Service (USFWS) was initiated on December 16, 2009 for the PBS and January 29, 2010 for the FTHL. The USFWS has preliminary concluded that the SWWTF upgrade will have no effect on listed species.

In the summers of 2007 and 2008, focused protocol surveys were conducted for the FTHL. Two FTHL 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. Based on the findings, it was determined that the entire plant site and off-site transmission line provide suitable habitat and food sources to support FTHLs.

Due to the small size and fragmented character of the small wetland area below the SWWTF, the area is considered sub-optimal for breeding use by Yuma clapper rail and other riparian bird species (Dudek 2009). Focused protocol surveys for the Yuma clapper rail, California black rail and other sensitive were conducted near the SWWTF in April and May of 2010. No individuals of any sensitive species had been detected at the time of submitting this analysis (URS 2010). It should be noted that most protocol surveys for listed birds are designed to detect birds during migration and courtship behavior on territories, with later surveys focused on determining breeding status and brood fledging. Early negative surveys usually result in no birds being detected during the breeding period either.

PBS were not observed during field surveys in 2007 and 2008; however, a small herd of five females and/or juveniles were observed in the north-central portion of the Project site during a site visit by Dr. Joe Platt of the company PBS&J on March 25, 2009. The USFWS is evaluating the potential use of the site by the PBS as foraging habitat. The USFWS results will be included in the joint Biological Opinion/Conference Opinion for the PBS/FTHL, respectively at the conclusion of the formal Section 7 Consultation with BLM and the Corps. At that time, the Corps will incorporate any additional analysis or information into the final 404(b)(1) analysis.

3.3.3 Fish, Crustaceans, Mollusks, and Other Aquatic Organisms in the Food Web

As presented in Section 3.1, no perennial or intermittent streams are present within the proposed project site, with the closest perennial drainage being the New River. In addition, the waterline from the proposed project site to the SWWTF would avoid all irrigation canals, ditches, and the New River either through spanning the water features along existing bridges or by directional boring.

As for aquatic organisms downstream of the SWWTF, it is well documented that the New River is highly polluted making it difficult for any aquatic life to thrive. The Regional Water Quality Control Board monitoring data show that dissolved oxygen (DO) concentrations in the New River near the Mexican Border are consistently below 1.0 mg/l, which represents a lethal environment for most aquatic organisms (e.g., there is not enough DO for the fish to breath) and violates the State standards for the New River. The SWWTF has in fact been a contributor to this problem—having been cited on multiple occasions for violating NPDES pollutant limits with their discharge to the river system.

Between 1993 and 2002 DeVlaming (2004) conducted a series of studies to assess water quality using three aquatic species from the New River: a cladoceran (*Ceriodaphnia dubia*), a mysid (*Neomysis mercedis*), and a larval fish (*Pimephales promelas*). Although no mortality was observed with the P. promelas, high-level toxicity to the invertebrate species was documented in samples from the New River during many months of each year. Toxicity identifications and chemical analyses identified the organophosphorus insecticides (OP), chlorpyrifos, and diazinon as the cause of *C. dubia* toxicity. The extent of the *C. dubia* mortality was highly correlated with quantities of these OPs applied in the watersheds. *C.*

dubia mortality occurred during more months of our 2001/2002 study than in the 1990s investigations. During 2001/2002, the extensive *C. dubia* mortality observed in New River samples was caused by OP insecticide pollution that likely originated from Mexico. Mortality to N. mercedis in New River samples was likely caused by contaminants other than OP insecticides. No aquatic sampling was conducted along the New River related to the IVSP.

3.3.4 Other Wildlife

The project area is known to support a variety of special status wildlife species. Due to the suitable habitat being present, most of the special status wildlife species listed in Biological Resources Table 2 (SA/DEIS Page C.2-17) have a moderate potential of occurring on the project site, though they were not detected during surveys. Species which were detected on-site, the detection of wildlife signs (i.e., scats, burrows, or tracks), or those species with a high potential for occurrence are discussed in more detail in the SA/DEIS, SSA, and in Sections 3.3 and 4.3 the Final EIS. Vegetation in the desert wash contains a greater vegetative diversity and density than the areas outside of the streams and provide wildlife habitat and movement corridors for the species listed in Biological Resources Table 2 (SA/DEIS Page C.2-17).

The area surrounding the proposed Project is dominated primarily by Sonoran creosote bush desert shrubland. Resident birds in this vegetation community include black-throated sparrows, loggerhead shrikes, LeConte's thrashers, and greater roadrunners. Several dry streams run through the Project area that collect precipitation and nutrients from the surrounding watershed, which promotes greater floral variety. These desert wash habitats are scarce within the arid environment but are estimated to support ninety percent of Sonoran Desert birdlife. Phainopeplas, ashthroated flycatchers, verdin, crissal, LeConte's, Bendire's thrashers, long-eared and western screech owls, black-tailed gnatcatchers, Gila and ladder-backed woodpeckers, Lucy's warblers, northern mockingbirds, and loggerhead shrikes, all inhabit desert streams (CalPIF 2006).

The USFWS developed the Birds of Conservation Concern (BCC) to accurately track the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent the highest conservation priorities and draw attention to species in need of conservation action (USFWS 2002). Table 15 lists the BCC species for Region 33 (Sonoran and Mojave Deserts-U.S. portion only) that have the potential to use the desert shrublands of the geographic scope as resident or wintering grounds.

Table 15. Birds of Conservation Concern for Region 33 (Sonoran and Mojave Deserts-U.S. portion only) that have the potential to be resident or wintering birds in the geographic extent.

Species	Status[1]
Mountain plover	Wintering
Burrowing owl	Resident
Gila woodpecker	Resident
Gilded flicker	Wintering
Loggerhead shrike	Resident
Le Conte's thrasher	Resident
Sage sparrow	Wintering

[1]Determination of whether birds had potential habitat in the Project area and their status was determined using *Birds of North America Online* (Poole 2005) and *Wildlife of Salton Sea National Wildlife Refuge, California* (USFWS 1993).

USFWS has identified several BCC that have the potential to migrate over the Project area and use the Salton Sea as a breeding area or wintering area. Table 16 identifies the BCC species for Region 33 (Sonoran and Mojave Deserts-U.S. portion only) that have the potential to migrate over the geographic scope of this analysis.

Table 16. Birds of Conservation Concern for Region 33 (Sonoran and Mojave Deserts-U.S. portion only) that have the potential to be resident or wintering birds in the geographic extent.

Species	Status[1]	Breeds at the Salton Sea	Winters at the Salton Sea
Black rail	Migrating	Y	N
Snowy plover	Migrating	Y	N
Whimbrel	Migrating	N	Y
Long-billed curlew	Migrating	N	Y
Marbled godwit	Migrating	N	Y
Red knot	Migrating	N	Y
Gull-billed tern	Migrating	Y	N
Black skimmer	Migrating	Y	N

[1]- Determination of whether birds had potential habitat in the Project area and their status was determined using *Birds of North America Online* (Poole 2005) and *Wildlife of Salton Sea National Wildlife Refuge, California* (USFWS 1993).

3.3.5 Special Aquatic Sites

The IVSP site does not contain any special aquatic sites. The jurisdictional WUS found on the project site include ephemeral streams that are largely dominated by upland plant species.

As described above, a small (less than 0.3 ac) brackish water emergent wetland occurs immediately downstream from the SWWTF outfall discharge. The wetland type typically occurs in streams, seeps, and other perennially-moist low places where the water table is close to or at the ground surface.

3.4 Potential Effects on Human Use Characteristics

3.4.1 Municipal and Private Water Supplies

Runoff from the ephemeral streams within the proposed project area does not recharge municipal or private water supplies. Therefore, no impacts are expected to municipal and private water supplies as a result of construction and operation of the proposed project.

3.4.2 Recreational and Commercial Fisheries

There are no recreational or commercial fisheries located in the New River, Westside Canal, or the Salton Sea. The proposed IVSP would not impact any recreational or commercial fisheries during its construction or operation.

3.4.3 Water-Related Recreation

The SA/DEIS and Final EIA did not identify any water-related recreation in the vicinity of the Proposed Project or any water-related recreation activities downstream of the Proposed Project that would be affected by the proposed project (Land Use, Recreation, and Wilderness section of the SA/DEIS and Land Use and Corridor Analysis, Recreation, and Special Designations of the Final EIS). The nearest water-related recreation is boating, kayaking, fishing, and migratory bird watching at the Salton Sea. There are seven marinas surrounding the Salton Sea, from which boaters and fisherman launch.

3.4.4 Aesthetics

The Visual Resources section of the SA/DEIS and Final EIS provides a comprehensive analysis of the proposed project in relation to the surrounding viewshed.

3.4.5 Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

The proposed IVSP is not located near any National Parks, Monuments, Seashores, or research sites. The wilderness areas closest to the proposed project site are: the Yuma Area of Critical Concern—which is adjacent to the southern boundary of the project site, the Jacob Wilderness located approximately 4 miles southeast of the project site, and the Coyote Mountains Wilderness located approximately 7 miles northeast of the project site immediately beyond the Anza Borrego State Park. For more information, see section C.8 – Land Use, Recreation, and Wilderness of the SA/DEIS or subsections 3.0 titled Land Use and Corridor Analysis, Recreation, Special Designations of the Final EIS.

4.0 Impacts Analysis

4.1 Impacts to Waters of the U.S.

4.1.1 Construction Impacts

Permanent impacts to the ephemeral streams will result from the placement of SunCatchers on 24-inch bases, and the construction and/or maintenance of the arterial and perimeter roads across project area streams. All stream crossings, with the exception of the Lifeline Road G will be at grade Arizona crossings. The Lifeline Road G will be spanned over Wash G with a concrete box culvert structure. Temporary impacts to the ephemeral streambeds include the underground placement of the electrical collection system and the hydrogen distribution system, and temporary construction disturbances associated with vehicle and equipment movement in streambeds (SES 2009e).

All arterial roads would be 24 feet in width and the main access route would be paved due to the high traffic. All the perimeter roads and maintenance routes down SunCatchers rows would be unpaved and 10 feet in width (Table 17). The unpaved roads would be treated with a soil tackifier to maintain the integrity of the road; however, none of the roads located within streams would be treated. Map 5 of Attachment B shows the proposed project layout with the location all roads, SunCatchers, the Main Services Complex, the off-site transmission line, and the off-site waterline that connects to the SWWTF.

The layout of the proposed IVSP would maintain the local pre-development drainage patterns except in a few locations such as the Main Services Complex and Substation, which are primarily situated in the uplands, but adjacent to secondary streams. Water discharge from the site would remain the same with western streams discharging to the north and eastern streams discharging at the eastern boundary of the project site. The paved roadways would have a low-flow, unpaved swale or roadway dip as needed to convey nuisance runoff to existing stream channels. It is expected that stormwater 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. This design is preliminary and may change upon further review by the Corps in the next design phase or based on the required review and approval by the Regional Water Quality Control Board (RWQCB) under the CWA Section 401 Certification process. In addition, the Final EIS includes a section titled "Mitigation, Project Design Features, and Other Measures" within each discipline area including Hydrology, Water Use and Water Quality. The Corps will incorporate these measures appropriately into the project or as Special Conditions of the permit to minimize storm water impacts.

Table 17. Types of impacts and the width or area of their disturbance.

Type of Impact	Width or Area of Disturbance
Arterial Roads (Paved)	24 feet
Perimeter Roads (Unpaved)	10 feet
Maintenance Roads (Unpaved)	10 feet
Main Services Complex	0.7 acres
Utility Trench	3 feet
SunCatcher Pedestal	4 square feet
Waterline	Co-located beneath perimeter road over Stream E

Arterial roads would cross 93 jurisdictional WUS. 36 of these arterial road crossings would be at-grade Arizona crossings. Diagram 1 of Attachment C shows a diagram of how they would be constructed. The crossing would be a low water crossing that is not paved and no tackifier would be applied.

Some impacts to jurisdictional streams were unavoidable due to safety and security concerns. According to multiple publications prepared by the American Association of State Highway and Transportation Officials (AASHTO), 10 foot wide lanes are acceptable on low-speed facilities to ensure the safety of the driver and any passengers. Likewise, on Page C.5-11 of the SA/DEIS, CEC's proposed conditions of certification HAZ-4 and HAZ-5 address both construction security and operations security plans and require that there be a perimeter fence and road installed to ensure the security of the site. In addition, the intersections of the arterial roads need to be a certain width in order to allow the flatbed trucks that transport the SunCatchers to the field to safely negotiate the intersections.

The preliminary LEDPA would not place SunCatchers or associated maintenance roads in the entirety of streams H, C, I, and K and the southern portions of streams E and G (Map 5 of Attachment B). Along the northern portions of streams E and G, a 200 foot wide corridor was left through the center of the wash as a FTHL movement corridor where SunCatchers will not be installed, but maintenance roads are still proposed. While placing SunCatchers in these streams was avoided or minimized, the applicant needs access throughout the project area and requires arterial and perimeter road crossings of the avoided streams. The applicant has reduced the number of crossings to only those they currently believe to be necessary for operation of the proposed project and to ensure that the perimeter of the project is secure. Table 18 lists the avoided streams and the number and type of road crossings per stream.

Table 18. Number and type of road crossings for the avoided washes.

	Primary Streams											
	I		C		K		E		G		H	
Type of Road	Number Of Crossings	Acres Of Impacts	Number Of Crossings	Acres Of Impacts	Number Of Crossings	Acres Of Impacts	Number Of Crossings	Acres Of Impacts	Number Of Crossings	Acres of Impacts	Number of Crossings	Acres of Impacts
Arterial	0	0	4	0.41	3	0.39	3	0.39	1	0.01	0	0
Perimeter	0	0	0	0	0	0	0	0	0	0	0	0
Fence	1	0.002	3	0.004	3	0.003	1	0.002	2	0.013	1	0.005
Total	1	0.002	7	0.533	5	0.533	7	0.393	3	0.015	1	0.005

The construction and installation of the SunCatchers and the requisite electric and hydrogen gas utilities requires excavation of two trenches that would parallel the rows of SunCatchers in a north-south direction. The necessary electrical lines would be in one trench and the hydrogen system would be in the other trench (Figure 8). The electrical trench would be 24 inches wide and 30 inches deep and the hydrogen trench would be 4 inches wide and 24 inches deep. Table 21 shows the temporary impacts that the trenching will have to primary and secondary streams.

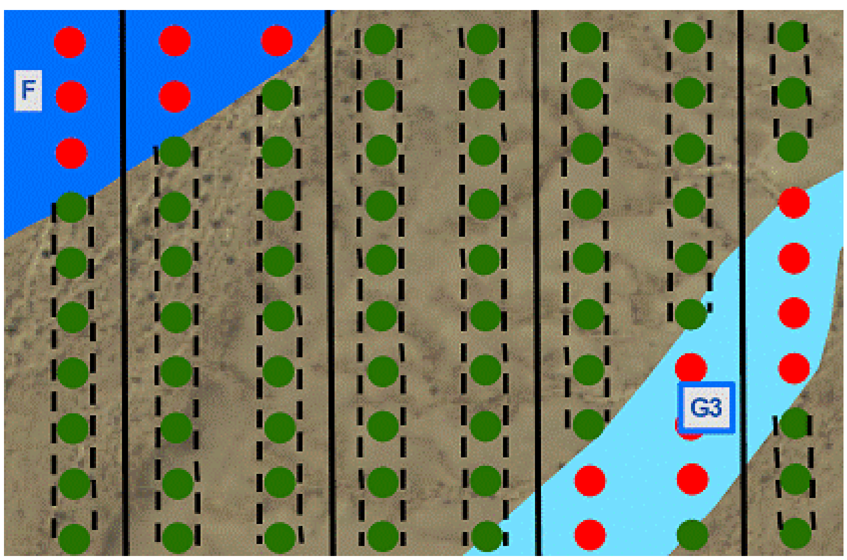


Figure 8. Current design of SunCatchers with maintenance roads bisecting two rows of SunCatchers with utility trenches running parallel to each side of the maintenance road. A utility trench then extends to each SunCatcher to connect it to the overall system.

Brush trimming in upland areas will be conducted between alternating rows of SunCatchers during construction only, in an effort to reduce fire ignition potential and to provide safe construction conditions. Brush trimming will consist of cutting the top of the existing brush while leaving the existing native plant root system in place to minimize soil erosion. It is anticipated that trimming will be limited to individual or groups of shrubs (no grasses or forbs) that occur along the utility trenches, at SunCatcher locations, and along project area road networks, to the extent practical. Within defined bed and bank areas of WUS, mowing will be limited to the occasional removal of shrubs that occur within the road crossing of a stream. Across streams, some vegetation will be trampled or uprooted during trenching (for hydrogen and electrical lines) activities in these areas. No mowing would occur within streams H, I, K, C, within the areas south of the transmission corridor for streams E and G or within the 200 foot wide wildlife movement corridors in streams E and G north of the transmission line. A restoration plan for temporary construction related impact areas will be developed that will include the reestablishment of the elevations and contours of the disturbance areas, revegetation to minimize soil and wind erosion, and weeding until the sites meet pre-disturbance conditions. During operation and to minimize shading on SunCatchers and prevent potential brush fire hazards, vegetation trimmings would occur by hand as necessary.

After brush has been trimmed, blading for roadways and foundations would be conducted between alternating rows to provide access to individual SunCatchers. Blading would consist of limited removal of terrain undulations. Although ground disturbance would be minimized wherever possible, the applicant proposes that 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%.

A perimeter fence is required by the CEC for security purposes and will surround the entire site (Diagram 2 of Attachment C). The perimeter fence will be installed 6-inches above the ground at stream crossings to allow for FTHL movement within the washes and adjacent uplands. In addition, the height and type of fence is expected to allow for unrestricted hydrologic and sediment transport because the soils on site are sand and there is an absence of woody vegetation or debris that can be caught up in the fence. The fence is chain link and will not affect FTHL movement in upland areas where the fence runs to the ground. A temporary perimeter fence would be constructed around Phase 1 of the project in order to secure the site during construction and operation. This temporary fence would be removed when Phase 2 is constructed and the area of temporary disturbance restored. The substation would also require an additional section of fencing. Fence posts would be constructed every ten feet and would be pushed into the substrate. Corner posts would require a concrete base be poured for stability. Corner posts would require a hole 12 to 18 inches wide and at least three feet deep (Diagrams 6 and 7 of Attachment C). Table 19 includes the total acres of permanent impacts from the installation of fence posts within jurisdictional streams. In total, the perimeter fence would have 0.13 acre of permanent impacts to WUS.

Table 19. Perimeter fence impacts to primary and secondary streams and the total number of crossings.

	Permanent		
Impacts	**Primary**	**Secondary**	**Total**
Perimeter Fence[2]	0.1	0.03	0.13

[1] – Number of fence posts was calculated assuming that there would be a fencepost every 10 feet.
[2] – Acres of impacts were calculated assuming a hole two feet in diameter.

An approximately 12-mile reclaimed water supply pipeline is proposed for construction from the SWWTF to the project site along Evan Hewes Highway. Off-site the proposed reclaimed water line would either span or go under seven irrigation canals and the New River. There would be no impacts to any of these canals, adjacent wetlands, or the New River as Best Management Practices (BMPs) would be utilized to avoid impacts to WUS. These BMPs include either boring under or using existing bridges or spans to cross the irrigation ditches, associated adjacent wetlands, and the New River. As required by the Corps and other regulatory agencies, the Applicant will develop a frac-out plan prior to any boring activities. On-site the waterline would be co-located (buried beneath) proposed roadways that cross Wash E. As such, no additional impacts to WUS are created by the proposed waterline.

Overall permanent and temporary impacts of the proposed project are listed in Table 21. This includes the permanent disturbance of placing 3,442 SunCatchers in jurisdictional streams (Table 20), all paved and unpaved roads constructed within jurisdictional streams, the construction of the Main Services Complex and Substation, and buried electric and hydrogen utility line trenches. No fill or dredging operations are anticipated with the proposed upgrade to the SWWTF.

Table 20. Number of SunCatchers in ephemeral streams for Phases 1 and 2 of construction.

Number of SunCatchers	Primary Streams	Secondary Streams	Total
Phase 1	376	568	944
Phase 2	1,591	713	2,304
Overall	1,967	1,281	3,248

The substation would be constructed within a small area (0.7 acre) of primary and secondary streams and would require a diversion ditch to reroute water away from the facility. Diagram 3 in Attachment C provides an engineered drawing that depicts how the stream would be diverted around the Substation building and complex. This design is under review by the Corps and will be modified, as necessary to ensure that the diversion does not retard hydrologic or sediment transport of the secondary stream and cause indirect impacts to downstream areas.

Table 21. Temporary and permanent impacts to jurisdictional streams due to construction of the proposed Imperial Valley Solar Project.

		Permanent		Temporary	
Impacts		Primary	Secondary	Primary	Secondary
Roads	Arterial Roads	7.4	2.7	0.0	0.0
	Perimeter Roads	2.0	0.5	0.0	0.0
	Maintenance Roads	15.2	9.2	0.0	0.0
	Temporary Road	0.03	0.2	0.0	0.0
Waterline		0.0	0.0	0.0	0.0
Main Services Complex		0.01	0.7	0.0	0.0
SunCatchers (2 ft diameter)[1]		0.2	0.1	0.0	0.0
Perimeter Fence[2]		0.1	0.03	0.0	0.0
Electrical and Hydrogen Trenches[3]		0.0	0.0	8.6	5.4
Total		**24.9**	**13.3**	**8.6**	**5.4**

[1] – Impacts for the SunCatcher pedestals were calculated at 8.86 x 10^{-5} acres (4 square feet) per pedestal (3,214 pedestals total).

4.1.2 Operational Impacts

During operation of the IVSP, the perimeter road would be regularly patrolled for security purposes. On average, the perimeter road would be used for surveillance 2 times a day. The perimeter road has 52 stream crossings. There would be a total of 3,120 stream crossings by vehicles per month for security purposes.

The SunCatchers require washing once a month to maintain efficiency. In addition, maintenance would be required as SunCatchers break down or require regular maintenance. There are 3,248 SunCatchers located in jurisdictional streams. It is assumed that each SunCatcher would be visited once a year for maintenance that would equal 13 vehicle trips annually to each SunCatcher. Over the course of an average month, there would be 3,518 crossings of the ephemeral streams for the regular maintenance of the SunCatchers. The vehicles would include a maintenance truck and a water truck. Table 22 shows the approximate number of stream crossings per month including the type of vehicles used during operation of the power plant.

The Applicant would not cross the streams when the streams are flowing or after rain events when the ground is soft except for emergency situations. As required by the Final EIS, the Applicant is required to prepare multiple plans to protect water quality from the construction and operation of the project. In particular, mitigation measures required by the Final EIS in the Hydrology, Water Use, and Water Quality Section include development of a Drainage Erosion and Sedimentation Control Plan, Industrial Facility SWPPP, and an NPDES General Permit for Construction Activity. One or several of these documents will include proper BMPs and protocols that require vehicles to be regularly maintained at appropriate locations within the Main Services Complex. No maintenance of vehicles in streams or along roads will be permitted unless in emergency situations. In the event that an emergency occurs and contaminants are released, one or several of these plans will contain BMPs and cleanup measures to be followed. See the Final EIS for details required within each plan.

Table 22. Wash crossings required monthly during normal operation of the proposed project including the type of vehicle.

Type of Activity	Vehicles used	Number of wash crosses per month
Patrolling the perimeter road[1]	Pickup Truck	3,120
Routine SunCatcher washing[2]	Water Truck	3,248
Routine and On-call SunCatcher maintenance[3]	Maintenance truck	271

1 – It is assumed that TSNA would patrol the perimeter of the project area two times a day.
2 – Each SunCatcher would be washed once a month.
3 – It is assumed that each SunCatcher would require maintenance once a year.

4.1.3 Indirect Effects Related to Scour and Vegetation Removal in Streams

An indirect effect of SunCatchers installed in streams would be the scour created around the pedestals during and after a rain event due to the obstruction in the flow path and due to the bare soil following vegetation removal. The hydraulics of flow were used to compute the depth of local scour as well as the area affected by scour using the equation recommended by the Federal Highway Administration given in Hydraulic Engineering Circular No. 18, FHWA, 2006 by Chang Consultants (2010b). Wash D was used as a sample wash to model the indirect effects of scour around SunCatcher pedestals placed in streams. Chang's modeling used a 100-year flood event as the precipitation event and determined that the average scour radius during the storm event was 44.9 square foot circle around the SunCatcher pedestal. The scour hole gets partially refilled during the falling stage of the storm flow (i.e., the scour hole becomes smaller by the end of the storm). It calculates that 50% of the scour depth is refilled toward the end of the storm for a scour disturbance of 21.9 square feet around the SunCatcher pedestal (Chang 2010b). Table 23 quantifies the indirect effects related to scour of the SunCatchers placed in the streams on the project site.

It is anticipated that scour repair would be ongoing throughout the life of the project but would only require maintenance following large flood events. In addition, it is anticipated that trimming and/or removal of vegetation within the streams would continue throughout the life of the project; however, maintenance trimming would consist primarily of removing any shrubs or trees that shade the SunCatchers and any vegetation that would impede the ability of the SunCatcher to track the sun.

Table 23. Acres of scour around the bases of the SunCatcher pedestals during a 100-year flood event.

	Primary		Secondary		Total	
Construction Phase	**# of SunCatchers**	**Acres of Scour[1]**	**# of SunCatchers**	**Acres of Scour[1]**	**# of SunCatchers**	**Acres of Scour[1]**
Phase 1	376	0.19	568	0.29	944	**0.47**
Phase 2	1,591	0.80	713	0.36	2,304	**1.16**
Overall	1,967	1.00	1,281	0.65	3,248	**1.64**

1 – Acres of scour were determined using 21.9 square feet of disturbance per SunCatcher pedestal during a 100-year storm event (Chang 2010b).

4.1.4 Direct and Indirect Impacts to the Stream Condition

The above direct and indirect effects during construction and operation of the proposed project have the potential to adversely affect the ephemeral streams found on the project site. CRAM was used to assess the functionality of these streams and the results are discussed in Section 3.1.2. By dividing the four attributes of the CRAM methodology into their respective metrics, it is possible to frame a discussion about projecting (e.g. estimating) the above direct and indirect effects of the proposed project on the functionality of the ephemeral streams. Using the above impacts combined with how CRAM calculates a score, estimates how individual metrics such as buffer condition, structural patch richness, and number of plant layers would be affected by the project. Some of the projections will be quantitative, but given how certain attributes of the established CRAM Riverine module (Physical and Biological) did not adapt well to the ephemeral streambeds, some of the projections will be qualitative. The projections below will be used in section 5.0 to determine adequate mitigation to replace the functionality lost due to the proposed project. More detailed impacts analysis for the physical, chemical, and biological properties of the ephemeral streams are included in sections 4.2 and 4.3.

It should be noted that multiplying a CRAM score by the area or linear distance of an ephemeral streambed may not represent the true relationship between conditions at different scales. CRAM scores do not represent a functional capacity on a per acre or per unit basis (CWMW 2009). The use of CRAM in estimating potential impacts onto the functionality of the ephemeral streams is only one component of calculating impacts and of determining the proper mitigation ratios.

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4.1.4.1 Buffer and Landscape Context

Landscape Connectivity Metric

For riverine wetlands, landscape connectivity is assessed as the continuity of the riparian corridor over a distance of about 500 meters upstream and 500 meters downstream of the assessment area. Of special concern is the ability of wildlife to enter the riparian area from adjacent upland buffer area and to move easily with adequate cover along the riparian corridor through the assessment area from upstream and downstream. Non-buffer land cover measuring more than 10 meters in length on either side of the stream riparian corridor upstream or downstream are considered breaks in the Landscape Connectivity. A description of what constitutes buffer can be found below in the "Buffer Metric" section.

The majority of the proposed project will be impacted by a network of unpaved maintenance roads, paved arterial and unpaved perimeter roads, utility trenches, and SunCatcher units spaced approximately 60 feet (north/south) by 112 feet (east/west) apart. The proposed project layout extends the roads and SunCatcher units through many of the ephemeral streams and up to the edge of most of the avoided primary streams (I, K, C, G, E, and H). Based on the current Riverine Module CRAM scoring method, this would effectively reduce the post-project scoring of the Landscape Connectivity metric to a "D" for all of the stream area in which the combined total length of non-buffer segments is greater than 200 meters either upstream or downstream.

Buffer Metric

The CRAM definition of Buffer "is the area adjoining the assessment area that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses that would severely detract from its ability to entrap contaminants, discourage forays into the assessment area by people and non-native predators, or otherwise protect the assessment area from stress and disturbance." The buffer metric is composed of three submetrics: (1) percentage of the AA perimeter that has a buffer; (2) the average buffer width; and (3) the condition or quality of the buffer.

The proposed project will introduce a level of anthropogenic use that would not fit the current CRAM definition or examples of buffer (Collins et al). The SCCWRP assessment found the highest scoring areas for this metric were in the center of the Site away from existing anthropogenic uses such as I-8, Even Hewes Highway, and Plaster City. This is the only metric that uses a formula incorporating the 3 submetrics to determine the final scoring. If the percent of the AA perimeter that has a buffer is reduced to 0 percent, the entire metric score automatically becomes the equivalent of an overall score of "D". Except for ephemeral streams at the perimeter (I, G, and H) where the SunCatcher network will only be placed on a single side of the stream, the percent of the perimeter with buffer of all streams is effectively reduced to 0 percent. Streams I, G, and H are also three of the six streams entirely or almost entirely avoided by the proposed project.

4.1.4.2 Hydrology

Water Source Metric

Water sources directly affect the extent, duration, and frequency of saturated or ponded conditions. Water sources include both natural and unnatural direct sources. Natural direct sources would include rainfall, groundwater discharge, and flooding. An example of an unnatural direct water source would be direct storm drain discharge.

The majority of the project site would remain 100 percent pervious, except for the arterial roads and building sites. The building sites consist of approximately 28 acres of impervious surfaces (buildings, paved parking, storage areas, etc.). The increased runoff expected from the building sites would be over-mitigated by capturing 100 percent of the runoff in a retention basin, where the storm runoff would be infiltrated and/or evaporated to the atmosphere. The Arterial roads consist of 104 acres of imperious surfaces. Unpaved maintenance and perimeter roads account for 219 acres and would be treated with a soil tackifier to maintain the integrity of the road except for within WUS. Unpaved roads treated with the tackifier have some degree of imperviousness necessary to stabilize the soil, but this percentage of impervious is currently unknown.

The maintenance plan requires that each SunCatcher unit will be washed 12 times per year. Total water use for 28,360 Suncatchers distributed over the 6,571 acre site is estimated to be 14.2 acre feet of water annually. The pan evaporation rate at the Site is over 140 inches per year, far exceeding the approximately 0.025 inches of water per year used over the 6,571 acre project site.

All of the 84 CRAM assessment sites scored an “A” for this metric (i.e. their freshwater sources are either precipitation or they naturally lack water in the dry season). There was no indication that unnatural (anthropogenic) sources of water contributed to any dry season flows. Because the majority of the project site will remain pervious and due to the high evaporation rate in the Yuha Desert, there would be virtually no change in the extent, duration, and frequency of saturated or ponded conditions of the ephemeral streams throughout the site and scoring of the Water Source metric would remain unchanged.

Channel Stability Metric

Channel stability is assessed as the degree of aggradation (i.e., net accumulation of sediment on the channel bed causing it to rise over time), or degradation (i.e., net loss of sediment from the bed causing it to be lower over time). Eighty three (83) percent of the CRAM assessment sites scored a “B” for the Channel Stability metric, 12 sites scored an “A,” and 5 sites scored a “C.” Some indicators of aggradation were observed at most sites, none of which were considered severe. This is supported by the description of flow characteristics contained in the Initial Drainage Study Report conducted by Stantec (2008). The report describes the project site as an alluvial plain in which sediment is still being deposited from the upstream alluvial fan areas.

The CRAM assessment sites scoring lower then a "B" were primarily located at the downstream (northern) end where diversion of the ephemeral streams toward culverts under the railroad and Evan Hewes Highway caused additional deposition of sediment.

The majority of direct impacts to ephemeral streams will consist of the unpaved maintenance roads, paved arterial and unpaved perimeter roads, maintenance roads, and utility trenches. Additionally, the placement of SunCatcher units within ephemeral streams will have direct and indirect impacts. All project maintenance roads and perimeter roads (10 feet wide) and arterial (24 feet wide) will be constructed at-grade to minimize their impact to site hydrology. The at-grade roads will be similar in their construction to the existing transmission line access road and the BLM road network throughout the site.

Chang Consultants (2010a) determined that the at-grade road crossing would not cause major changes in sediment pattern. Chang Consultants (2010c) conducted an updated evaluation of the currently proposed project in which they reviewed changes to the proposed project along with areas of the project site not covered in the previous study; north of the existing transmission line and south of Evan Hewes Highway. From their modeling study, Chang Consultants determined that the streams within the proposed area of impact would not be subject to substantial changes in channel bed profiles for the existing and proposed conditions. This is additionally supported by the CRAM assessment where the 6 assessment areas located directly upstream and downstream of the existing transmission line road all scored a "B" or above.

Chang Consultants (2010b) also conducted a study of local scour around the 2 foot diameter pedestals on which the SunCatcher units will be installed. The pedestal supporting the each SunCatcher unit placed within the ephemeral streams will induce local scour during storm flow similar to that found around bridge piers. Scour analysis was based on modeling for the 100 year storm event. The results of the study indicate that while the area and depth of scour is largest during peak flow, the scour area becomes partially filled back in as storm flow recedes. Chang Consultants determined that the total area affected by the indirect effects of local scour around SunCatcher pedestals is less than one percent of the wash area.

The Channel Stability metric is assessed using a worksheet to identify observed field indicators of channel equilibrium, active degradation, and active aggradation. The 84 CRAM assessment sites had a cumulative total of 198 indicators of equilibrium, 31 indicators of degradation, and 162 indicators of aggradation. Because of the landscape position of the project site in the watershed, there is a continuous input of sediment delivered to the project site from the upstream areas. While some localized scour is expected directly around SunCatcher pedestals, the effects are minimal in relation to the overall area of the ephemeral streams and the amount of sediment coming into the project site.

The indirect effects of the project roads, utility lines, and SunCatcher pedestals and vegetation clearing on Channel Stability as assessed in CRAM would not be expected to change for the six streams that are avoided or almost entirely avoided (I, K, C, E, G, and H). It is probable; however, that the network of paved and unpaved roads, particularly maintenance roads, that would need to be constructed (e.g. cut) into stream banks would cause localized erosion at each bank crossing. In addition, where SunCatchers are placed near the banks of each stream, either within the streambed or in the uplands adjacent to the bank, localized scour and erosion would likely occur. The degree that localized scour and erosion would occur is exacerbated by the proposed vegetation removal both in the uplands and in the streambeds surrounding the SunCatchers. Neither the effects of vegetation removal, nor the location of the placement of each SunCatcher can be accounted for in the hydrologic and sediment transport modeling completed by Chang Consultants. Nonetheless, these types of effects are likely and observed regularly along dirt roads and stream crossings throughout the arid west. Therefore, it is the Corps determination that the increased erosion at these locations would amount to substantially more indicators of aggradations and degradation within the post-project CRAM assessment areas (e.g. maintenance road crossings would occur on average every 200-feet, which would be approximately 3 or more crossings per CRAM assessment area for the post-project condition). The Corps therefore concludes that the proposed project would effectively reduce the post-project scoring of the Channel Stability metric to an average of "C" for the assessment areas not avoided.

Hydrologic Connectivity Metric

Hydrologic connectivity is assessed based on the degree of channel entrenchment, or the inability of flows in a channel to exceed the channel banks. For riverine systems, this metric is calculated as the flood-prone width divided by the bankfull width. As mentioned previously in 3.1.2.2, the conceptual model and field techniques used to assess this metric under the current CRAM Riverine Module (Version 5.02) will require reevaluation for arid streams. Using this CRAM User's Manual, 93% of the assessment areas scored and "A", indicating that channels were generally not entrenched.

The SCCRWP CRAM assessment (Attachment D) found that the concept of "bankfull" as described in the CRAM User's Manual (Collins et al 2008) does not appear to apply to arid ephemeral systems such as those found on the project site. SCCWRP indicated a revision of this metric that considers the connectivity between multiple channels in the floodplain as well as the upstream condition of the contributing watershed may be a more appropriate measure for arid streams. This concept is further supported by the drainage study of the primary ephemeral streams on the site conducted by Stantec (2008) in which 10 and 100-year discharges were modeled. The 10-year modeled cross section could be considered analogous to the current CRAM riverine concept of flood prone area. The cross sectional depth of modeled 10-year discharges was less than 2 feet deep in all of the modeled cross-sections for primary ephemeral streams except one of the four cross-sections for stream G. The estimated cross-sectional widths ranged up to 575 feet and all except 4 of the 21 modeled cross-sections were greater than 100 feet in width.

The indicators of bankfull and floodprone width and depth, as described in the CRAM User's Manual, could not be accurately measured in most of the ephemeral streams on the project site because of the very subtle changes in channel depth (<2 foot) relative to the channel width (>100 feet in many cases). Therefore visual estimates of entrenchment were used to determine scoring for many of the CRAM assessment areas. The shallow, wide nature of most of the onsite ephemeral streams along with the subtle topographic transition to adjacent upland areas indicates that there is little to no entrenchment

Channel entrenchment can also be described as the degree to which the channel is incised. Chang Consultants (2010a and 2010c) assessed stream longitudinal profiles through the project site and the effects of post-project impacts. The currently proposed project incorporates changes recommended by Chang Consultants (2010a) to mitigate sediment transport impacts which could produce localized scour and incision of the ephemeral stream channels throughout the project site. Chang Consultants (2010c) reevaluated the impacts after incorporation of recommended mitigation measures; primarily the removal of all sediment basins and the use of at-grade road crossings throughout the entire project. With these mitigation measures, the changes in channel bed elevation due to general scour were estimated to be less than 1 foot during the modeled 100-year flood and even less during the 10-year event. The general scour analysis provides the best indication of potential for channel entrenchment (channel incision). Additionally, the at-grade road crossings, utility lines, and SunCatchers have been designed to minimally impact the existing morphology of the ephemeral stream channels. Therefore, using similar methods to the SCCRWP CRAM assessment for estimating Hydrologic Connectivity, no significant changes in metric scoring are expected.

4.1.4.3 Physical Structure

Physical Patch Type Metric

Several components of the proposed project would impact the physical structure of the ephemeral streambeds (See Sections 4.1.1, 4.1.2, and 4.1.3 for details). The construction of the roads and utility trenches would impact approximately 5.6% of the ephemeral streams (Table 24). It is expected that the roads and utility trenches constructed within the project area and would have some impacts on the physical features of the streams, including the physical patch types that are measured for this metric. Roads would be constructed in a grid across the proposed project area and the two utility trenches would run parallel to the rows of SunCatchers including all the streams not designated for avoidance (Map 5 of Attachment B). Heavy equipment including flatbed trailers, cranes, and water trucks would be driving to each SunCatcher location for the installation and/or maintenance of the SunCatchers. Even though there will be no grading done within the streams, there will be grading at stream banks for road crossings and the weight of the vehicles accessing SunCatchers in the streams will create a disruption in the natural physical patch types measured for this metric.

The majority of sites had four patch types observed within the assessment area boundaries (Figure 6). Of the four major patch types observed (secondary channels, hummocks/sediment mounds, point/in-channel bars, and variegated foreshore), it is projected that the proposed project would remove an average of one of these patch types within primary streams. Since the secondary streams are not as wide as the primary streams assessed within the project area (average active floodplain width of 28.2 m versus 57.4 m for primary streams), it is projected that the proposed project would remove an average of two patch types within the secondary streams. For the avoided streams, there are only a few road and fence crossings and no SunCatchers are placed within these streams (Table 18). No reduction in physical patch types is expected for these areas.

The Physical Patch Type Metric is scored by the number of patch types observed within an assessment area. For the project area, the majority of sites scored a “D” (48%) for this metric, which is the lowest score possible (See section 3.1.2.3 for a summary or Attachment D for a full report). Therefore, the scores for these sites would not change. For primary streams that are not avoided, there were ten sites that scored a “B” or a “C” for this metric. Reducing the patch types by one would decrease 3 sites from a “C” to a “D” and no sites from a “B” to a “C”. Since CRAM metric scoring of 6-7 patch types is a “B” and 4-5 patch types is a “C,” a reduction of two patch types for secondary streams would reduce all scores of a “B” to a “C” and a “C” to a “D.” 16 assessment sites scored a “C” and five sites scored a “B” for structural patch richness for secondary streams. These assessment sites would all be reduced by one letter grade. Scores would not change for assessment sites within primary streams that are avoided.

It should be noted that this is one of the metrics identified in the SCCWRP CRAM report that would require modification for arid, ephemeral stream systems, such as deleting/adding patch types for more accurate scoring of this metric (Attachment D). The initial low scoring of this metric may tend to diminish any differences seen between assessment sites and separate streams because to achieve higher scores the metric requires more patch types than are present within these less complex, ephemeral streams.

Topographic Complexity Metric

The ephemeral streams in the project area did not contain any elevation changes or “breaks,” which is what this metric measures. The proposed project would need to grade stream banks at road crossings in order to create safe slopes for each dirt maintenance road; however, the proposed project would not grade the bottom of the roads within the streams. Therefore, the at grade crossings are not expected to disrupt sediment transfer through the project area (Chang 2010a; Chang 2010b: RMT 2009). All sites scored a “C” or “D” for this metric and it is not expected that the proposed project would interfere with the topographic complexity of the streams except at road crossings. In order for an assessment site to score a “D,” there needs to be a man-made change to the channel bottom (Figure 9) which is not projected for this project (Chang 2010a; Chang 2010b; RMT 2009). Therefore, no change is currently projected for this metric from the proposed project. However, it’s important to note that this has been estimated using a hydrologic model in which small changes in sediment transport is not expected to be captured. The Corps will reevaluate all of the CRAM metrics, in particular those that could be affected by grading road crossings or removing vegetation once 70-100% project designs are provided by the Applicant.

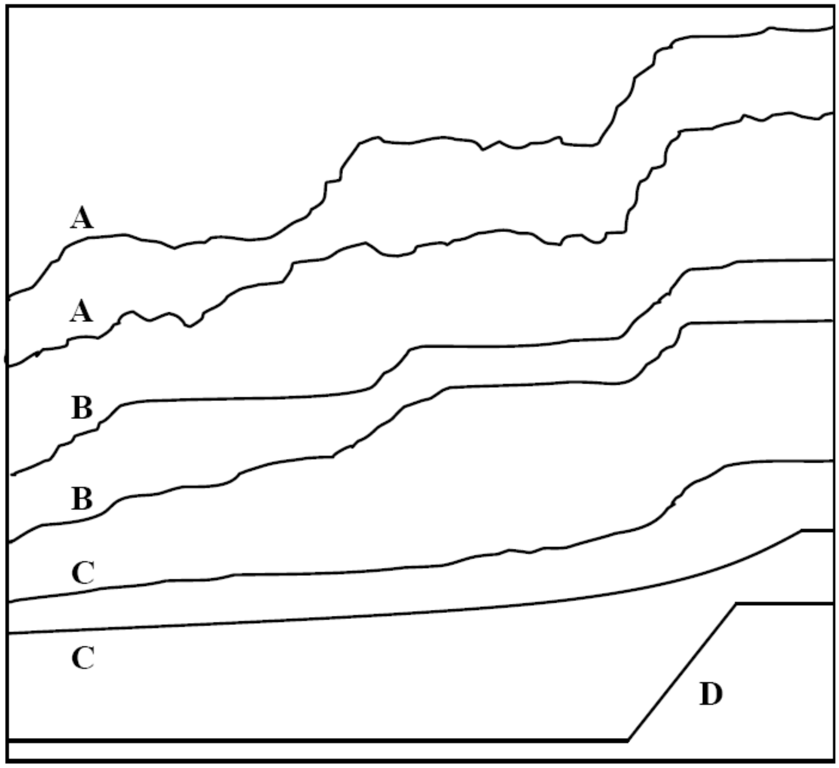


Figure 9. Rating of Topographic Complexity for all Riverine Wetlands.

It should be noted that this is another of the metrics where the current Riverine module does not adapt well to arid ephemeral stream systems (Attachment D). The CRAM report states; “Because aridland streams experience extreme and rapid variations in flood regime, the formation of benches is not a process that is expected to occur. Revised cross-section diagrams for arid stream systems would assist in interpretation of the topographic complexity metric, and potentially generate more variable scores for this metric [Attachment D].” It is expected that this metric will be altered in future CRAM Riverine Module revisons to better assess the topographic complexity observed within ephemeral stream systems when an ephemeral stream CRAM module is designed.

4.1.4.4 Biological Structure

Biotic Structure also generally scored low for all assessment areas due to the extreme nature of the Yuha Desert environment. The Biological Structure Attribute measures how plants influence the “quantity, quality, and spatial distribution of water and sediment within wetlands” (Collins et al 2008). Since the diversity and cover of plants is sparse within the project area, the corresponding CRAM scores for Biological Structure are lower than for other Riverine systems.

Plant Community Composition

The plant community composition metric is composed of three sub-metrics. Projections of CRAM scores for each sub-metric are described below.

Number of Plant Layers

Vegetation clearing within ephemeral streams will be limited to construction of roads and utility trenches. There would also be trampling and crushing of vegetation associated with the temporary impact areas for installation of the SunCatchers (Section 4.3.1). Only the taller plant species (ocotillo, mesquite, and smoke tree) would be systematically removed near SunCatchers to allow for movement of the SunCatcher and to prevent shading. However, these species are rarely present in most streams and when present provide sparse cover (usually less than 1% cover). None of the species that would be included in the medium and short plant layers would be specifically targeted during vegetation removal, but the potential effects of shading by the SunCatchers have not yet been evaluated.

It is estimated that approximately 1.6% of vegetation would be cleared within the ephemeral streams for the construction of roads and the utility trenches (Table 24). An additional 10% of vegetation has the potential for trampling or crushing within the temporary impact areas for SunCatcher installation; however, a certain percentage of these plants would remain intact (Table 25). It is currently estimated that approximately 11.6% of the vegetation within the streams is exposed to potential impacts.

The majority of sites assessed had 1-2 plant layers (75 assessment sites) with only nine sites having three plant layers (includes a tall plant layer). Since the ephemeral streams would retain approximately 27% of their plant cover after construction (Table 24) with an additional 10% of vegetation exposed within the temporary impact areas (Table 25), all assessment sites would likely retain 1-2 plant layers and still score as a "C." A tall plant layer was observed in nine of the assessment sites. This included four assessment sites that are located within primary streams proposed for avoidance. It is likely that the vegetation clearing would remove the tall plant layer from the five sites where it was observed outside of the avoided streams. However, the tall plant layer would remain in the primary streams where SunCatchers would not be installation. This would reduce the scores for these sites from a "B" to a "C."

Number of Co-Dominant Species

As described above, only species that have a very limited distribution within the ephemeral streams on the Site (i.e. those species in the tall layer) would be systematically removed where they interfere with the operation of the SunCatchers. Overall, the 1.6% reduction in plant cover with another 9% exposed to impacts within the temporary impact areas would have the potential to decrease the number of co-dominant species within an assessment site.

47 of the 84 sites scored a "D" (five or less co-dominant species) for this sub-metric and these scores would not change with the implementation of the proposed project. Of the remaining assessment sites, 35 scored a "C" (6-8 co-dominant species) and two scored a "B" (9-11 co-dominant species). Of these scores, seven of the assessment sites that scored a "C" and one that scored a "B" are located in primary streams where the applicant would not install SunCatchers. In order for a species to be considered a co-dominant, it must contain at least 10% of the relative cover within the coverage area of an individual plant layer. If approximately 11.6% of plant cover is at risk for vegetation clearing, trampling, or crushing, it

is expected that up to two co-dominant species would no longer meet the criteria for a co-dominant for a given assessment site. This would reduce the scores for these assessment sites one letter (i.e., an "B" to a "C" and a "C" to a "D"). This would not apply to the eight assessment sites that are located within the avoided primary streams. These scores would remain the same since there would only be a few perimeter and arterial road crossings (Table 18).

Percent Invasion

The number of invasive co-dominant species is assessed as a percentage of the total number of co-dominants. There were several invasive co-dominant species observed within the project area. The Asian mustard was the most commonly observed (40 of the 84 assessment sites). It is well documented that invasive species excel at colonizing areas after ground disturbance as proposed for this project. The Asian mustard is already established on the northern sections of the project area and any other areas of ground disturbance would likely be invaded by this species and others.

The applicant has committed to a Noxious Weed Management Plan for the entire proposed project area (SES 2009b). Certain species, including the Asian mustard, have been identified for eradication wherever encountered within the project area. With ongoing implementation of the Noxious Weed Management Plan, it is anticipated that scores for this sub-metric would not change. If implemented correctly, it is likely that Asian mustard infestations across the project area would decrease and this would have the potential to increase scores in this sub-metric. However, no projections of increased CRAM scores for the Percent Invasion sub-metric would be anticipated at this time. .

Horizontal Interspersion and Zonation

During vegetation clearing for the road system and electric and hydrogen trenching, it is not expected for any one plant community to be targeted above the others. In addition, only approximately one percent of plant cover within the streams would be removed during construction activities and will be confined to defined areas (road construction and trenching activities) (Table 24). However, some of the horizontal structure of the plant communities may be affected by construction activities from the removal of discrete patches of vegetation.

The majority of assessment sites scored a "C" or a "D" for this metric. However, there was some variability in the scores for this metric with 26% of the sites assessed scoring an "A" or "B". Assessment sites that scored a "C" or "D" are already simplistic systems without much variation or interspersion between plant communities and the amount of vegetation clearing proposed would not disrupt plant communities on a large enough scale to reduce sites that scored a "C" to a "D."

However, sites that scored an "A" or a "B" indicate that these sites have greater horizontal biotic structure (i.e. there are larger number of unique plant zones that are interspersed throughout the riparian area). It is likely that the construction of the access roads and installation of the SunCatchers within these sections of the streams would have a greater impact on this metric. It is projected that the vegetation clearing combined with the potential for trampling and/or crushing of vegetation within the temporary disturbance areas would impact the horizontal structure of the plant communities within these assessment sites and reduce the scores for these systems by one letter (i.e., an "A" to a "B" and a "B" to a "C"). Seven of the sites that scored an "A" or "B" are located within avoided primary streams where there will be no vegetation clearing for the installation of SunCatchers. The scores for these sites would not change. There is one site that scored an "A" that would be reduced and 14 sites that scored a "B" that would be reduced by a letter grade.

Vertical Biotic Structure

The vertical component of biotic structure is assessed by using the number of plant layers calculated in the Plant Community Composition Metric and observing the vertical overlap of the identified plant layers. The ephemeral stream plant systems are by necessity simple with very few plant layers (average of 2 plant layers for the CRAM assessment [Attachment D]) that do not contain much if any vertical structure overall due to the scarcity of water and other necessary resources. The majority of sites scored a "D" for this metric and will not be further impacted by the proposed project. Six assessment sites scored a "C" due to the presence of three plant layers. As discussed above for the Plant Community Composition Metric, it is expected that those sites with three plant layers (includes a tall plant layer) would be reduced to two plant layers through vegetation clearing. Two of these sites are located within the primary streams that where no SunCatchers would be installed. These two sites would retain their tall plant layer and their Vertical Biotic Structure scores would not be reduced. The remaining four sites would have their scores for the Vertical Biotic Structure reduced to a "D" as defined in the CRAM manual (Collins et al 2008).

4.1.4.5 Summary of Impacts to Stream Condition

At this time, the Corps has completed only a cursory evaluation of the CRAM scores in order to roughly estimate direct and indirect effects of the proposed 709MW project. The Corps will expand upon this evaluation once 70-100% project designs are provided by the Applicant. The final evaluation and estimate of indirect effects will be calculated for avoided streams (e.g. I, K, C, E, G, and H) and impacted streams. As described above, the Corps estimates that the scores for avoided and unavoided streams will be reduced most significantly for the Buffer and Landscape Attribute lowering from an average of "A" to the lowest score possible which is "D". Changes in the Hydrology Attribute will be less severe. The average baseline score for the Hydrologic Attribute is "A" and this would not be reduced for avoided streams (e.g. I, K, C, E, G, and H). The Hydrology Attribute would be reduced for one of the three metrics from "A" to "B". The Physical and Biological Attributes scored the lowest for the baseline due to the absence of structure typical in the desert environment compared to coastal stream systems for which CRAM is currently most applicable. The scores for both attributes range from the low end of "C" to "D". These would likely all be lowered to "D" for impacted streams due to maintenance roads and removal of vegetation and remain unchanged for avoided streams (e.g. I, K, C, E, G, and H).

Therefore, it's preliminarily estimated that the CRAM there would be a 15-20% functional loss for avoided streams due to impacts to the Buffer and Landscape Attribute and approximately a 30-40% functional loss in impacted streams due to effects of roads, SunCatchers, and vegetation removal on three of the four attributes (e.g. Hydrology Attribute will unlikely be affected to a measurable degree). The reduction at the proposed project site will be mitigated by improving the functions and services at the mitigation site at an appropriate acreage ratio to be determined by the Corps during final analysis.

4.2 Physical and Chemical Impacts

4.2.1 Physical Substrate Impacts

Construction and Operation Impacts

Construction of the project is expected to take approximately 40 months to complete. Construction would include soil excavation, clearing, grading, installation of solar disks, construction of the Main Services Complex, roads, utilities, water pipeline, substation, and other ancillary features. During these activities there would be both permanent and temporary impacts to the physical substrate of WUS from dredge and fill activities and construction of permanent facilities. Of these impacts, only the installation of SunCatcher pedestals into streams would penetrate into the substrate of WUS (to a depth beyond sand layers in streams). SunCatcher pedestals would be vibrated into the ground to approximately 17 feet in depth at 3,248 locations resulting in 0.3 acre of disturbance to WUS. This small disturbance is not expected to fracture shallow substrate layers that could result in cross mixing between shallow aquifers or result in drainage of perched aquifers. In fact, the shallowest known depth to groundwater on the project site is 45 feet but is in the 100-300 feet depth range for most of the site.

Other potential impacts to the surface substrate of WUS would be from periodic vehicle crossings of WUS via at-grade, unsurfaced crossings. Chang (2010a) determined that impacts to site geomorphology, as well as downstream morphology, would be insignificant (and in witness testimony to the CEC). As detailed in the SA/DEIS and in the Final EIS, the project is expected to generate short-term increases in erosion during construction.

Mitigation Measures

In accordance with the Final EIS, Soil&Water-1 and Soil&Water-3, the Applicant has prepared ***Drainage, Erosion and Sediment Control Plan (DESCP)*** and an ***Industrial Facility SWPPP***, respectively which describes a series of BMPs intended to reduce erosion during construction and operation of the facility. Multiple additional conditions of certification to minimize erosion are also detailed in the SA/DEIS and Final EIS. Upon review of these draft documents required by the Final EIS, or upon further evaluation of recent sediment transport or hydrology studies, or modification of the project design features, the Corps may incorporate Special Conditions of the IP that further mitigate these potential affects.

4.2.2 Water Circulation, Fluctuation, and Salinity Impacts

Construction and Operational Impacts

SunCatcher foundation poles in the flow path would create local areas of flow turbulence, resulting in local stream scour around the foundation poles. Scour such as this occurs on bridge piers, resulting in the need to bury bridge piers to a depth below the depth of scour to ensure stability. Chang (2010b) modeled the extent of scour for a SunCatcher pedestal during a 100-year flood event and determined the extent of scouring was a 21.9 square foot circle around the pedestal. Table 23 includes the indirect impacts of pedestal scouring during a 100-year flood event for the project site. Because project area streams are generally very wide, flows are typically very shallow and of low velocity. Flow velocities and depths for the 100-year flood as estimated from the HEC-RAS modeling are fairly uniform across the site. Flow depths on the site average approximately 1.2 feet, with flow velocities approximately 3 feet per second (Stantec Consulting, Inc. 2008), HEC-HMS (Stantec Consulting, Inc. 2008), HydroCAD (RMT, Inc. 2009), and FLUVIAL-12 (CHANG 2010a). Chang's sediment modeling study (2010a) and subsequent testimony submitted to the CEC showed that the project will not change hydrology, sediment flow or delivery towards areas downstream from the project site, or change stream morphology on or off site.

Mitigation Measures

Final EIS Mitigation Measures *Soil&Water-*7, **Storm Water Damage Monitoring and Response Plan**, is proposed to prevent soil surface damage and contamination resulting from SunCatcher instability in all areas. Condition of Certification *Soil&Water-1*, ***Drainage Erosion and Sedimentation Control Plan***, would also mitigate impacts associated with stream scour and SunCatcher instability, as well as ensuring no substantial increase in off-site flooding potential. Condition of Certification *Soil&Water-1* and *Soil&Water-7* are designed to ensure hydrology and flooding impacts are kept to less than significant levels. Upon review of these draft documents required by the Final EIS, or upon further evaluation of recent sediment transport or hydrology studies, modification of the project design features, or communication with the RWQCB, the Corps may incorporate Special Conditions of the IP that further mitigate these potential affects.

4.2.3 Suspended Particulate/Turbidity Impacts

Construction and Operation Impacts

Stormwater runoff from the site during construction could include excess sediment from construction activities. Chang's sediment modeling study (2010a) showed that with the sediment basins removed from the site plan, that the project will not change sediment flow or delivery towards areas downstream from the project site. Further, as the project will not change flow or sediment flow to off-site areas, there should be no impacts to off-site fluvial morphology.

Mitigation Measures

Per the Final EIS, site construction would require an ***Industrial Facility SWPPP***, Soil&Water-3 which would specify BMPs that would minimize mobilization of sediments and soils on-site and eliminate or reduce non-stormwater discharges to WUS. Mitigation Measures contained in the

Final EIS *Soil&Water-1,* ***Drainage, Erosion and Sediment Control Plan (DESCP),*** and *Soil&Water-5,* ***NPDES General Permit for Construction Activity****,* would ensure adequate control of construction stormwater pollutants.

Final EIS Mitigation Measures *Soil&Water-1,* ***Drainage, Erosion and Sediment Control Plan (DESCP),*** *and Soil&Water-5,* ***NPDES General Permit for Construction Activity****,* would ensure minimization of operations-related stormwater runoff contaminants and mitigate to a level less than significant. Upon review of these draft documents required by the Final EIS, or upon further evaluation of recent sediment transport or hydrology studies, modification of the project design features, or communication with the RWQCB, the Corps may incorporate Special Conditions of the IP that further mitigate these potential affects.

4.2.4 Contaminant Impacts

Construction and Operation Impacts

During construction and operation of the IVSP, surface water quality could be affected through the introduction of pollutants such as excess trash, oils, solvents, paints, cleaners, asphaltic emulsions, mortar mix, spilled fuel, vehicle fluids, and other construction or industrial site-related contaminants.

Runoff from the Main Services Complex would be directed into a one-acre stormwater retention pond. Runoff-borne contaminants from the Main Services Complex would be discharged into the retention basin, rather than being discharged into the natural channel system. The project would include an oil/water interceptor to collect oil and other contaminants from the Main Services Complex. Oil collected from this interceptor would be transported to a certified recycling facility.

Mitigation Measures

The Applicant proposes to collect and remove construction waste, including hazardous wastes, according to a regular schedule. Site construction would adhere to the required SWPPP Conditions of Certification *Soil&Water-1* and *Soil&Water-5* would ensure adequate control of construction stormwater pollutants.

Mitigation Measures in the Final EIS *Soil&Water-1* strive to ensure no adverse water quality or soils impact from mirror washing. Condition of Certification *Soil&Water-1* and *Soil&Water-5* would ensure minimization of operations-related stormwater runoff contaminants and mitigate to a level less than significant in all areas. Upon review of these draft documents required by the Final EIS, or upon further evaluation of recent sediment transport or hydrology studies, modification of the project design features, or communication with the RWQCB, the Corps may incorporate Special Conditions of the IP that further mitigate these potential affects.

4.3 Biological Impacts

4.3.1 Impacts to the Vegetation Communities

The predominant vegetation community on-site including within the streams is Sonoran creosote bush scrub. Vegetation trimming within the ephemeral streams will be limited to the occasional removal of shrubs that occur within the maintenance, perimeter, and arterial road crossings. Some trampling or uprooting of vegetation is expected to occur during trenching for the hydrogen and electrical lines. Vegetation clearing in the streams will be closely monitored because the highest density of vegetation occurs within the streams and removal would likely increase the potential for erosion and sediment transport to downstream reaches. The applicant has committed to not mow, trim, or otherwise disturb vegetation, nor place SunCatchers within streams I, K, C, H, and the areas of streams E and G south of the transmission line corridor. In addition, roads within these streams have been minimizes to only Perimeter and Arterial Road crossings. To accommodate the FTHL movement through the site, the Applicant has proposed to maintain 200 foot corridors in streams E and G north of the transmission line corridor (Map 5 of Attachment B) where no SunCatchers will be placed, but where maintenance roads may still be needed. The number of maintenance roads within the 200 foot wide corridors is extensive and will further be evaluated, and likely reduced, by the Corps when revised project design maps and vegetation clearing plans are developed.

Complete and permanent vegetation *removal* is expected for the construction and operation of roads within the streams, uplands. Complete temporarily vegetation removal would occur in order to trench and install the utilities (24 inches wide for electric/12-inches wide for hydrogen). A total of 14.3 acres of vegetation is estimated to be cleared for both temporary and construction related impacts within the streams for the entire project area; representing approximately 1.6 percent of site vegetation cover in WUS. However, total vegetation clearing across the project site including the uplands is approximately 135 acres.

Table 24 calculates the acres of vegetation that would be *removed, both temporarily and permanently* during the construction and maintenance of the road system and during construction of the electric and hydrogen trenches within ephemeral streams.

Table 24. Estimated vegetation removal by stream for construction of the road system and the electric and hydrogen trenches.

Label	Size of Drainages	% Overall Plant Cover	Acres of Disturbance	% of Drainage Impacted	Estimated Acres of Vegetation Cleared[1]	% of Vegetation Remaining	Decrease in % Cover
A	25	22%	1.80	7.2%	0.40	20%	1.6%
B	10	22%	0.93	9.3%	0.20	20%	2.0%
C	40	22%	0.42	1.0%	0.09	22%	0.2%
Secondary C Streams	44	34%	3.04	6.9%	1.04	32%	2.4%
D	75	22%	5.88	7.8%	1.29	20%	1.7%
Secondary D Streams	62	34%	4.48	7.2%	1.52	32%	2.5%
E	199	22%	13.33	6.7%	2.93	21%	1.5%
Secondary E Streams	37	34%	2.15	5.8%	0.73	32%	2.0%
F	104	22%	7.21	6.9%	1.59	20%	1.5%
Secondary F Streams	24	34%	1.65	6.9%	0.56	32%	2.3%
G	115	22%	3.96	3.4%	0.87	21%	0.8%
Secondary G Streams	37	34%	2.39	6.5%	0.81	32%	2.2%
H	7	22%	0.0	0.0%	0.00	22%	0.0%
I	24	22%	0.0	0.0%	0.00	22%	0.0%
J	11	34%	0.90	8.2%	0.31	31%	2.8%
K	37	22%	0.54	1.5%	0.12	22%	0.3%
Secondary K Streams	8	34%	0.56	7.0%	0.19	32%	2.4%
SI	22	34%	1.81	8.2%	0.62	31%	2.8%
Total	881	28%	51.06	5.8%	14.30	26%	1.6%

[1] – Estimated acres of vegetation cleared includes the width of the roads and the width of the utility and hydrogen trenches (3 feet).

Direct, but temporary impacts to vegetation is also expected through trampling and/or crushing during the installation of the SunCatchers and the construction of the two utility trenches (electrical and hydrogen) from heavy equipment operation in streams. It is estimated that a forty foot radius around each SunCatcher would be impacted by vehicle and equipment movement during installation of SunCatchers and an additional temporary disturbance from vehicle/equipment overland travel from the maintenance road network to the 40 foot radius impact area around individual SunCatchers.

Construction activities that would occur within the 40 foot radius temporary impact area are detailed as follows:

- Installation begins with delivery of the SunCatcher pedestal by a flatbed truck via the maintenance road to individual SunCatcher locations.

- The pedestal is then unloaded and put in position with a forklift. The installation is accomplished using a track crane fitted with a vibratory pile driving system. The crane is capable of picking up the pedestal off the ground, aligning the pedestal over the insertion point and vibrating the pedestal into the ground. The entire pedestal process takes 20 to 30 minutes.

- There are three other operations requiring man lifts and cranes:; (1) the azimuth drives – which are mounted on top of the pedestal: (2) the dish structure—which is mounted on the azimuth drive, and (3) the final stage is to mount and connect the Power Conversion Unit to the Dish Structure and the hydrogen lines and electrical connections which are mounted on the pedestals.

- The final stages require the use of a crane and the delivery of the SunCatcher apparatus on a flatbed truck.

All of these activities would occur within the 40 foot radius around the SunCatcher pedestal. It is expected that the activities would be short-term but of high intensity and would result in the trampling and crushing of vegetation. Because of the overlap of this 40 foot radius impact area between SunCatchers, all trenching activities for utilities would fall within this temporary impact area.

As shown in Table 25, approximately 332 acres of temporary construction activities would occur in WUS and another 2, 559 acres outside of the WUS in the uplands. Based on an average vegetation cover of 22% in primary streams and 34% in secondary streams, approximately 93.0 acres of vegetation within the streams may be damaged or destroyed during temporary construction activities.

Indirect impacts associated with vegetation clearing include weed infestation from permanent and temporary disturbed areas, and the potential destruction of natural soil binding and stabilization structures of live root systems from both temporary construction-related activities and operational activities. These disturbances can have widespread long lasting effects on the surrounding landscape and in particular downstream reaches if not mitigated adequately. If unmanaged, weeds will spread from the matrix of dirt maintenance roads and other facilities into the avoided uplands and streams to compete with native desert vegetation for water and nutrients.

Table 25. Estimated temporary impacts to vegetation by trampling during installation of the SunCatchers and construction of the electric and hydrogen trenches.

Label	Size of Drainage	% Overall Plant Cover	Acres within the Temporary Disturbance Zone	Potential Indirect Impacts to Vegetation[1]
A	25	22%	15.7	3.5
B	10	22%	5.6	1.2
C	40	22%	0.0	0.0
Secondary C Streams	44	34%	24.9	8.5
D	75	22%	46.8	10.3
Secondary D Streams	62	34%	33.2	11.3
E	199	22%	70.6	15.5
Secondary E Streams	37	34%	13.3	4.5
F	104	22%	47.8	10.5
Secondary F Streams	24	34%	11.6	3.9
G	115	22%	21.2	4.7
Secondary G Streams	37	34%	16.3	5.5
H	7	22%	0.1	0.0
I	24	22%	0.0	0.0
J	11	34%	6.4	2.2
K	37	22%	0.1	0.0
Secondary K Streams	8	34%	4.3	1.5
SI	22	34%	14.1	4.8
Total	881	28%	332.0	93.0

[1] – Acres of vegetation exposed to trampling and/or crushing was estimated using the acres of the temporary disturbance zones multiplied by the average plant cover for primary and secondary streams.

Mitigation Measures

The SA/DEIS and Final EIS propose numerous measures to mitigate the direct and indirect impacts to biological resources. Specific to vegetation, *Bio-7,* ***Biological Resources Mitigation Implementation and Monitoring Plan (BRMIMP)****, Bio-8,* ***Construction- & Operation-Related Minimization Measures****, Bio-10,* ***Mitigation for FTHL***, Bio-17, **Mitigation for CDFG Jurisdictional Streambeds and Corps Jurisdictional Waters of the U.S.**, and Bio-18, **Noxious Weed Management Plan.** Combined these measures will allow only the minimum vegetation clearing and disturbance necessary to construct the proposed project, require the management of noxious weeds during construction and operational of the plant, and require mitigation for all unavoidable impacts to CDFG and Corps WUS.

In addition, the Applicant and the Corps are working together on the development of an on-site revegetation plan for temporary impact areas, as well as an off-site mitigation plan in accordance with the Mitigation Rule for unavoidable direct, indirect, and cumulative impacts (see section 5.0). Any temporary impacts to Corps WUS associated with trenching or installation of SunCatchers would require restoration of the stream and contributing uplands within the buffer areas to the pre-existing elevations, contours, and vegetation communities immediately following construction. Bio-17, ***Mitigation for CDFG Jurisdictional Streambeds and Corps Jurisdictional Waters of the U.S.,*** describes the current approach of the Corps in mitigating unavoidable impacts through requiring mitigation in the form of enhancement and rehabilitation of Carrizo Creek and marsh on the Anza Borrego State Park. Mitigation ratios would likely range from 3:1 to 5:1 based on the final evaluation of direct and indirect impacts to the functions and services on-site relative to the benefit of the enhancement and rehabilitation activities on Carrizo Creek. At this time, it is estimated that the required mitigation for PBS and Corps jurisdictional WUS would be similar, on the order of 250 acres of enhancement and rehabilitation in Carrizo Creek and marsh, known foraging areas for the PBS.

4.3.2 Threatened and Endangered Animals Impacts

Flat-tailed horn lizard

Impacts associated with the Proposed Action on threatened and endangered species is discussed in detail in Section C.2 of the SA/DEIS, in Chapter 4.3 the Final EIS, and the Biological Assessment attached to the Final EIS.

It has been determined that the project would likely adversely affect the flat-tailed horned lizard. Approximately 6,500 acres of FTHL suitable habitat would be directly affected by the project. This represents 0.66% of the estimated amount (400,000 hectares) of suitable habitat occurring in California. As described below, the SA/DEIS and Final EIS states the Conditions of Certification and Mitigation Measures, respectively the Applicant proposes to reduce and minimize impacts to the FTHL. The preliminary LEDPA would provide corridors for FTHL to traverse the proposed project site. Streams C, I, and K would only have crossings for the Perimeter and Arterial Roads and the perimeter fence (Table 18) with no SunCatchers or maintenance roads built within the stream (Map 5 of Attachment B). These streams traverse the entire site from I-8 to the south to Evan Hewes Highway and the railroad dike to the north. The culvert under I-8 for wash C allows for FTHL movement; however, the culverts underneath I-8 currently restrict movement through streams I and K (Figure 10). These culverts may be further modified to allow for FTHL movement, but may not be a mitigation measure of this project. The at-grade crossings on the project site would not impede FTHL travel from south to north.

Streams E and G on the eastern section of the project would not have SunCatchers or maintenance roads in the southern portion of the project area up to the existing transmission line road. In addition, TSNA has agreed to provide 200 foot corridors that are free of SunCatchers along the northern portion of the streams (reduction of 228 SunCatchers in WUS). The corridor is expected to provide FTHL with the ability to traverse the entire eastern portion of the project area with only a few road crossings; however, at this time there would be 23 maintenance road crossings of Stream E and 8 road crossings of Stream G. The maintenance roads within the streams throughout the site would be used approximately once a month to wash and maintain the SunCatchers (Table 22). This would reduce the potential for FTHL mortality by vehicles and allow the FTHL relatively undisturbed streams for their movement. The number of these roads may change with further analysis and consultation between the federal agencies (e.g. USFWS, BLM and Corps) prior to finalizing the 404(b)(1) analysis.

The culverts under I-8 restrict movement from the Yuha Desert FTHL Management Area located south of the project site (Figure 10). While providing these FTHL transportation corridors on the eastern and western portions of the project site would not mitigate the impacts to the remaining acres of potential FTHL habitat impacted within the project area, it would allow the FTHL relatively unimpeded passageways through the project area and allow some limited movement between the two FTHL Management Areas (Yuha Desert and West Mesa). The avoidance measures would preserve 242 acres of desert streams and potential FTHL habitat. As stated below, it is expected that the applicant would still mitigate the loss of FTHL habitat as defined by the FTHL Management Strategy and outlined in the Section C.2 of the SA/DEIS and in Bio-10 of the Final EIS.

Mitigation Measures

The full list of mitigation measures for biological resources is listed on pages C.2-74 through C.2-100 of the SA/DEIS and in section 4.3 of the Final EIS. There are three Mitigation Measure specifically designed for the FTHL; Mitigation Measure *Bio-9*, ***Construction Related Avoidance and Minimization Measures for the FTHL***, *Bio-10*, ***Mitigation for the FTHL, and*** Bio-11**,** ***FTHL Designative Biologist***. These measures would minimize and/or mitigate for impacts to FTHL populations and habitat through implementing pre-construction surveys and removal of FTHLs from construction areas, providing the regulatory agencies reasonable access and an experienced biological monitor, and by acquiring compensation lands equal to the acreage of the project site within the FTHL Management Area, which is approximately 6,527 acres of lands.

Peninsular Bighorn Sheep

A group of five female/yearling Peninsular bighorn sheep (PBS) were observed in an ephemeral stream on the western half of the project site in March 2009. Although this species could use the IVSP site as foraging habitat, data collected for this project suggests that use of the project site by PBS is transitory and likely a result of drought conditions. As the IVSP is located on flat terrain, sheep entering the area are far from escape habitat and would be in a highly stressed state. This could put them at great risk as the project site is already surrounded by busy highways and the railroad. Nonetheless, in preliminary consultation with the USFWS, it has been determined that the project site provides some forage and may possibly function as a corridor for PBS movement. The USFWS and BLM biologists agree that the observation of PBS on the site in spring 2009 was an unusual occurrence because no known lambing sites or water sites are known near the project site and no other PBS occurrences been documented in the vicinity.

The USFWS is in the process of preparing a Biological Opinion (BO) and it is anticipated that the final outcome of which will be that the IVSP may affect, but is unlikely to adversely affect PBS. The Proposed Project would not adversely affect PBS Designated Critical Habitat. Potential incidental take would likely be in the form of harassment and no mortality of PBS is anticipated. Subsequently, the USFWS anticipates requiring mitigation in the form of enhancement or restoration for the estimated 250 acres foraging habitat on the project site. Mitigation for this foraging habitat would be consistent and overlapping with the Corps proposed mitigation approach at Carrizo Creek and marsh described previously.

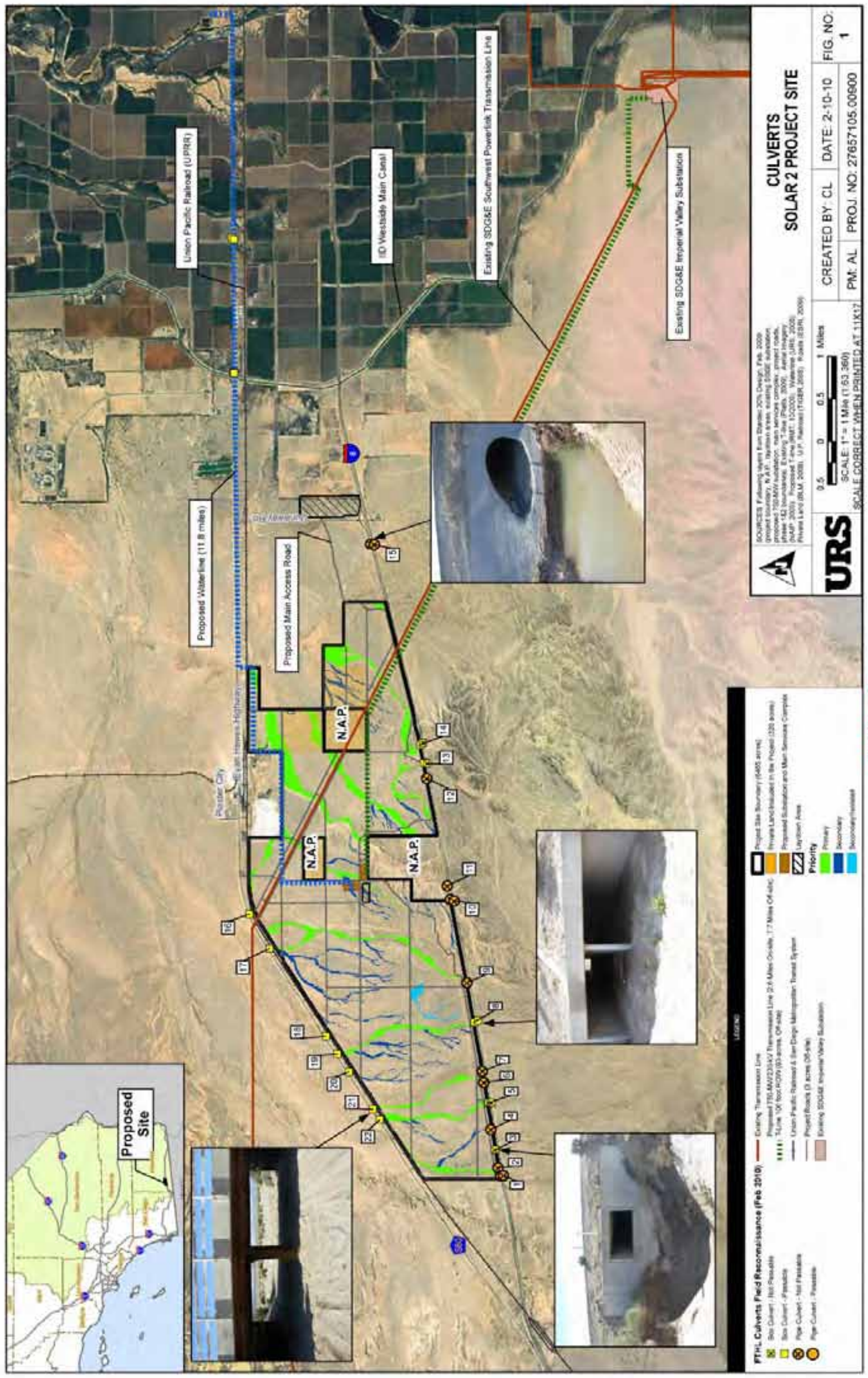
Mitigation Measures

Condition of Certification of the SA/DEIS and Final EIS Mitigation Measure Bio-8, ***Construction and Operation Minimization Measures***, requires that a perimeter fence and gates to prevent wildlife access to the site be constructed. The measure also requires that construction equipment is contained on-site excavated areas are covered, and that wildlife escape ramps in the excavated areas should be constructed in the event that sheep wander on-site. Mitigation Measure BIO-17, ***Mitigation of CDFG Streambeds and Corps Waters of the U.S***, would include mitigating impacts to Corps jurisdictional WUS through the enhancement of Carrizo Creek and Marsh on Anza Borrego State Parks in known PBS territory. Mitigation at Carrizo Creek and the adjacent marsh consisting of riparian enhancement and creation is expected to benefit PBS by restoring historical forage areas that have been lost due to tamarisk invasion. Enhancement efforts are expected to remove tamarisk and restore the drainage and marsh to a condition of native forage for PBS. With implementation of the identified Mitigation Measures and mitigation required by the USFWS, the IVSP is not likely to adversely affect special-status mammals.

Other sensitive species

The Proposed Project may affect, but is unlikely to adversely affect the Yuma clapper rail. This determination is based on the potential that marginal habitat downstream of the SWWTF would be degraded from the small reduction in flows. Focused surveys along the New River near the SWWTF for the Yuma clapper rail and for burrowing owl, California black rail, least Bell's vireo, southwestern willow flycatcher, and western yellow-billed cuckoo have all been negative in 2010.

Figure 10. Culverts on the perimeter of the project site and the ability of FTHL to cross them.



4.3.3 Fish, Crustaceans, Mollusks, and Other Aquatic Organisms in the Food Web

No fish, crustaceans, mollusks, or other aquatic organisms were observed within the project site. Therefore, no impacts are expected to these organisms from the Proposed Project.
The SWWTF expansion would not fill any wetlands along the New River. During operation of the project, a small portion of the effluent from the SWWTF would be used for the project (up to 33.7 acre feet). The small reduction in effluent discharge is not anticipated to impact the small wetland located immediately downstream of the SWWTF discharge point, as this wetland is also fed by agricultural return flow. The minimal decrease in flows to the New River (estimated to represent between 0.03% to 0.16% of the total flow in the New River) is not anticipated to a have a measurable impact on the New River or the Salton Sea.

4.3.4 Other Wildlife

Impacts to other BLM or state listed wildlife are discussed in section C.2 of the SA/DEIS and 4.3 of the Final EIS. The full list of mitigation measures for biological resources is listed on pages C.2-74 through C.2-100 of the SA/DEIS.

The LEDPA would reduce permanent impacts to streams within the project area by 138.4 acres compared to the original proposed project (Tables 3 and 5). In addition, the LEDPA would not place SunCatchers or associated maintenance roads in streams C, I, and K and the southern portions of streams E and G (Map 5 of Attachment B). The only impacts to these sections are perpendicular arterial or perimeter road crossings and the perimeter fence (Table 18). This would provide habitat for the numerous animal species that utilize the denser wash vegetation and provide corridors of movement through the project area. In addition, 200-foot wide corridor without SunCatchers through the northern portions of streams E and G would provide corridors through the eastern half of the project area.

4.3.5 Special Aquatic Sites

The proposed project site does not include any special aquatic sites.

4.4 Impacts on Human Use Characteristics

4.4.1 Municipal and Private Water Supplies

None.

4.4.2 Recreational and Commercial Fisheries

None.

4.4.3 Water-Related Recreation

None.

4.4.4 Aesthetics

See the Visual Resources section (C.13) of the SA/DEIS for a detailed discussion of the Proposed Action's impacts to the viewshed.

4.4.5 Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites and Similar Preserves

See the Land Use, Recreation, and Wilderness section of the SA/DEIS and Final EIS for a detailed description of the impacts analysis.

4.5 Determination of Cumulative Effects on WUS

Cumulative effects associated with the Proposed Action are described in detail in SSA and in the Final EIS. The SSA and Final EIS found that there would be no cumulative impacts to Air Quality, Facility Design, Geology, Paleontology, and Minerals, Hazardous Materials, Noise, Public Health and Safety, Socioeconomics and Environmental Justice, Traffic and Transportation, Transmission Line Safety/Nuisance, Transmission System Engineering, Waste Management, and Worker Safety and Fire Protection. Please see the SSA and Final EIS for detailed analysis on these environmental parameters. The SSA and Final EIS found that cumulative impacts were significant and unavoidable following mitigation for Land Use and Recreation and Visual Resources. The SSA final determination for a Biological Resources and Hydrology, Soils and Water Resources also determined that the proposed project would result in significant and unavoidable cumulative impacts following mitigation; however, this analysis referred to the 750MW alternative and impacts to the FTHL and WUS have been significantly reduced. The 750MW Alternative included 165 acres of impacts of WUS which have been reduced to 38 acres of impacts to WUS through avoidance and minimization measures resulting in the 709MW alternative. The Final EIS analyzed the 709MW alternative and found the impacts to FTHL and WUS to be acceptable with implementation of Mitigation Measures (see below).

The Corps geographic scope of analysis for impacts to jurisdictional WUS is the three HUC 12 watersheds to which the IVSP contributes hydrology, sediment, and biological resource values. These are Lower Coyote, Plaster City, and Middle Coyote watershed, which are all part of the southwestern part of the HUC 8 Salton Sea Watershed. As described previously, mitigation that the Corps will require for unavoidable impacts to WUS would occur in Carrizo Creek, which is located in the HUC 8 Carrizo Creek Watershed directly to the north of the IVSP, draining into San Felipe Creek and then to the Salton Sea. Enhancement and rehabilitation of Carrizo Creek and marsh at this location will mitigate the functions, services, and acreage of indirect and direct impacts to WUS and restore known PBS historic foraging resources.

A search of the Corps database produced no completed permit actions within the geographic scope of the Corps analysis. These three HUC 8 watersheds are essentially open space with some detrimental, but unregulated activities on-going including site scraping on a property south of the southwest corner of the project site and off-road vehicle uses. It is assumed that the development of Plaster City, Evan Hewes Hwy, the railroad, and I-8 were developed either prior to the CWA, activities were unregulated, or activities were minor in nature and permitted through the Corps Nationwide Permit Program for mining/industrial/commercial facilities and linear transportation projects, respectively. The Corps then expanded the database search beyond the three HUC 8 watershed to Imperial County and 25 regulatory actions completed, two of which were Standard Individual Permits (SIP). These permit actions across Imperial County amounted to approximately 136 acres of impacts to WUS. On-going and reasonably foreseeable permit actions (e.g. those actively engaging the Corps in pre-application meetings) with the Corps are shown in Table 26.

Table 26. Corps On-Going and Reasonably Foreseeable Projects

File Number	Project Name	Status	Location	Impact acreage	Mitigation acreage
2010-00024	Black Rock Geothermal Plant	Permit pending	33.04851°N,-115.7375°W	~0.15 acre ephemeral stream	TBD
2010-00140	Wind Zero Police Academy	Pre-application	32.72942°N, -115.9485°W	TBD	TBD
2009-00445	Calexico Clean-up	Permit issued July 24, 2009	32.67782°N, -115.5428°W	Temporary 2.0 acre of wetland	Re-vegetate 2.0 acre of wetland
2009-00569	Brawley Closure	Pre-application	32.99861°N, -115.5398°W	approx. 1600 linear feet of New River	TBD
2009-00141	Calexico New River Project (Underground New River)	Pre-application	From 32.665°N, -115.499°W To: 32.6789°N, -115.5424W°	3 miles of New River	TBD
2010-00643	Bridge Replacements County of Imperial Brockman Road	Pre-application	32.7375°N, -115.6378°W	>0.10 acre New river	TBD
	Lyons Road		32.7169°N,-115.6042°W	>0.10 acre New river	TBD
	Drew Road		32.7616°N,-115.6903°W	>0.10 acre New river	TBD
	Worthington Road		32.8471°N,-115.6826°W	>0.10 acre New river	TBD
	Evan Hewes Highway		32.7910°N,-115.7017°W	>0.10 acre New river	TBD
	Hetzel Road Bridge		32.8218°N, -115.7296°W	>0.10 acre Salt Creek	TBD
	Brockman Road		32.7001°N,-115.6398°W	>0.10 acre JD Canal	TBD
	Westmorland Road		32.8422°N, -115.7378°W	>0.10 acre JD Canal	TBD
2010-00645	Observational Deck Sonny Bono	Pre-application	33.0829°N, -115.7092°W	TBD	TBD
2010-00543	Habitat Pond	Pre-	33.183°N,	TBD	TBD

	Restoration Sonny Bono	application	-115.6228°W		
2010-00142	DFG Habitat Ponds 2400 acres	Pre-application	New River mouth: 33.1022°N, -115.6869°W and/or Alamo River mouth: 33.1841°N, -115.5976°W	TBD	TBD
2010-00391	Anza Borrego Carrizo Creek ILF	Pre-application	32.8477°N, -116.1974°W	TBD	TBD
2010-00461	Superstition Solar	Pre-application	33.0628°N, -115.756°W	TBD	TBD
2007-00567	Imperial Solar Energy South	Pre-application	32.65879°N, -115.6611°W	TBD	TBD
2000-00570	Imperial Solar Energy West	Pre-application	32.77145°N, -115.7834°W	TBD	TBD
2007-00704	Sunrise Powerlink	Permit Pending	Linear: from Suncrest Substation in San Diego County to Imperial Valley Substation in Imperial County	Approx. 2.86 acres of permanent impacts (0.078 wetland) and 7.28 acres of temporary impacts to waters of the U.S.	TBD
2009-00971	Ocotillo Express Wind Energy	Pre-application	32.743°N, -116.054°W	TBD	TBD
2009-00969	Tule Wind	Pre-application	32.72840°N, -116.31°W	Approx. 0.15 acre of ephemeral stream	TBD

Per the Final EIS, the proposed project would be expected to contribute only a small amount to the possible short term cumulative effects related to biological resources because the proposed mitigation measures described below would minimize and offset the projects contributions to the cumulative loss of habitat for native plant communities and wildlife, including special-status species. Mitigation Measure BIO-10 requires the applicant to pay for the acquisition of 6,619.9 ac of suitable habitat for FTHL. This habitat would be connected to other suitable habitat for other special-status species, and would offset any habitat loss associated with the project. In addition, the proposed project design has avoided all or most of six of the ten primary streams (e.g. I, K, C, E, G, and H) and avoiding a 200-foot wide corridor within the two primary streams not completely avoided (e.g. E and G) for the FTHL. This avoidance allows the FTHL to continue to utilize the project site to some degree. Cumulative loss of foraging habitat for PBS is also expected to be insubstantial and will be mitigated through the enhancement and rehabilitation of equal acreage of foraging habitat within known PBS populations and movement corridors (e.g. Carrizo Creek as described above). The Final EIS further includes a host of measures designed to mitigate the direct, indirect, and cumulative effects of the proposed project on biological resources. These include Mitigation Measures BIO-16 requires protection and passive relocation for burrowing owls and BIO-12 (the Raven Management and Monitoring Plan) includes measures that would address the cumulative regional increases in raven predation on FTHL. Mitigation Measure BIO-19 requires pre-construction surveys and a special-status plant protection plan. Mitigation Measure BIO-17 requires that the effects to the desert streams be mitigated by offsetting cumulative losses to waters of the U.S. and CDFG jurisdictional streambeds also designed to mitigate the losses to PBS foraging habitat. The contribution of the IVS project to cumulative effects will be less than considerable with appropriate levels of compensatory mitigation, when Mitigation Measures BIO-10 and BIO-17 are applied. Similarly, the contribution of the IVS project to the combined effect of the cumulative projects in the FTHL habitat can be mitigated with Mitigation Measures BIO-10 and BIO-17.

The proposed project would be located in the Yuha Desert of Imperial County in an area characterized by braided, erosive stream channels, flash flooding, alluvial fan conditions, low rainfall, sparse vegetation, and the potential for wind erosion. There are no perennial or intermittent drainages on the IVSP site. Hydrology and the water quality of surface runoff flows would be dependent on materials picked up on the ground surface, which is currently natural desert. The downstream disposition of surface runoff from the site is the desert area west of the Westside Main Canal, possibly the Westside Main Canal itself, local drainage and irrigation ditches west of the Westside Main Canal, the New River, and eventually the Salton Sea. Cumulative impacts to water quality are not anticipated because of the low amount of rainfall received in the region and the irregularity of subsequent flow events, the lack of impervious surfaces in the watersheds, and the type of proposed project (e.g. limited imperious surfaces). Mitigation Measures within the Final EIS have been designed to limit the potential effects on hydrology and water quality and ensure that the proposed project complies with applicable regulatory requirements for both construction and post-development surface runoff water quality. These regulatory requirements not only apply to the proposed project, but all future projects. Therefore, cumulative impacts on surface water quality of receiving waters from the proposed project and future alternative energy projects in the watershed would be addressed through compliance with the applicable regulatory requirements that are intended to be protective of beneficial uses of the receiving waters. In addition, Mitigation Measures in the Final EIS include Soil&Water-1, Development of a Drainage, Erosion and Sediment Control Plan (DESCP), which would include monitoring and rectifying any observed problems during operation; Soil&Water-5, NPDES General Permit for Construction Activity, would ensure adequate control of construction stormwater pollutants; and Soil&Water-3. Industrial Facility SWPPP, which would specify BMPs that would minimize mobilization of sediments and soils on-site and eliminate or reduce non-stormwater discharges to WUS.

5.0 Mitigation Proposed by the Applicant

For unavoidable impacts to WUS, the Applicant proposes to replace the functional losses through active wetlands and riparian habitat enhancement, rehabilitation, and preservation. The permanent impacts to WUS (e.g., ephemeral streams) are 38.2 acres, temporary impacts from the utility trenches are 14.0 acres, indirect impacts due to scour are estimated at 1.64 acres, and temporary disturbances have the potential to disturb up to 93.0 acres of vegetation within the ephemeral streams. Direct and indirect impacts associated with construction and operation of the project on stream condition have been estimated using CRAM as previously described in Section 4.1.4. This loss of stream condition has not been converted into acreage losses directly. Instead, the loss of stream condition will be mitigated by comparing the on-site baseline vs. post-project conditions with the mitigation site baseline vs. post-mitigation conditions. Final mitigation requirements will be calculated following a more complete evaluation of the CRAM scores prepared by the Southern California Coastal Water Research Project (SCCWRP), which were only recently provided, as well as the Corps estimated effects on those CRAM scores from construction and operation of the proposed project , and estimated gains at the proposed mitigation site.

At this time, the Corps is directing the mitigation planning effort to enhancement and rehabilitation of Carrizo Creek and marsh located west/northwest of the project on the Anza Borrego State Park. Carrizo Creek was chosen by the Corps in coordination with the Applicant and the State Park because of its close proximity to the project, its current protected status (State Park), and because it's within known PBS populations. The IVSP is located in the HUC 8 Salton Sea Watershed with ephemeral streams that are tributary to either Coyote Wash or the Westside Main Canal prior to flowing into the Salton Sea. Carrizo Creek is located in the HUC 8 Carrizo Creek watershed directly to the north, draining into San Felipe Creek and then to the Salton Sea. In coordination with the Corps and State Parks, the Applicant is preparing a draft enhancement and rehabilitation plan that will cover approximately 25 miles of the Carrizo Creek from the headwaters downstream through Carrizo Marsh. State Parks has provided preliminary Tamarisk (*Tamarix* spp.) infestation mapping which will be updated by the Applicant, methods for removal, and potential costs. The enhancement and rehabilitation plan will be prepared in accordance with the Corps' and EPA Final Mitigation Rule (33 CFR Parts 325 and 332 [40 CFR Part 230]) and will include detailed methods for the initial removal, retreatment methods, limited native replanting of honey and screw bean mesquite trees (*Prosopis glandulosa* and *P. pubescens,* respectively) and arrow weed (*Pluchea sericea*), in Carrizo Marsh, monitoring and reporting protocols, and performance standards partly based on CRAM. The Corps is unlikely to require the applicant to enhance and rehabilitate this entire 25-mile reach of Carrizo Creek to mitigate on-site direct and indirect impacts. The Corps mitigation requirement will likely be on the order of a 3:1 to 5:1 mitigation ratio depending on the enhancement plan and other data currently being collected. It is the Corps approach that the applicant will initiate the first phase of the enhancement effort equal to their final mitigation requirements and that the remainder will be completed as required by other agencies (USFWS or CDFG) or completed by other applicants either through establishing an in-lieu fee program, additional permittee-responsible mitigation, or completed by the State Park through grant funding.

In addition, approximately 6,527 acres of creosote bush shrubland will be preserved to offset adverse impacts to the FTHL (see Condition of Certification and Mitigation Measure *Bio-10,* ***Mitigation for FTHL*** in the SSA and Final EIS, respectively). The exact location of the preservation lands are unknown at this point, but it is anticipated that these locations would have similar ephemeral streambeds as the proposed project area and that these streams would be preserved.

The details of the proposed compensatory mitigation measures, responsible parties, mitigation goals and objectives, implementation schedule, and monitoring and success criteria will be included in a Mitigation and Monitoring Plan to be prepared in accordance with the Mitigation Rule and approved by the Corps before implementation of the proposed project.

In addition to the compensatory mitigation at Carrizo Creek and 6,527 acres of preservation of FTHL habitat, the Applicant proposed other mitigation measures that are specific to state and federally-listed and/or BLM-listed species. These measures are intended to ameliorate or offset the loss in sensitive habitat that supports these species. The mitigation measures specific to the proposed project area are located in the Biological Section and Hydrology, Water Use, and Water Quality sections of the SA/DEIS, SSA, and the Final EIS. Those mitigation measures specific to the SWWTF are locatedin the Seeley Environmental Review Update docketed with the CEC on May 10th, 2010 (URS 2010).

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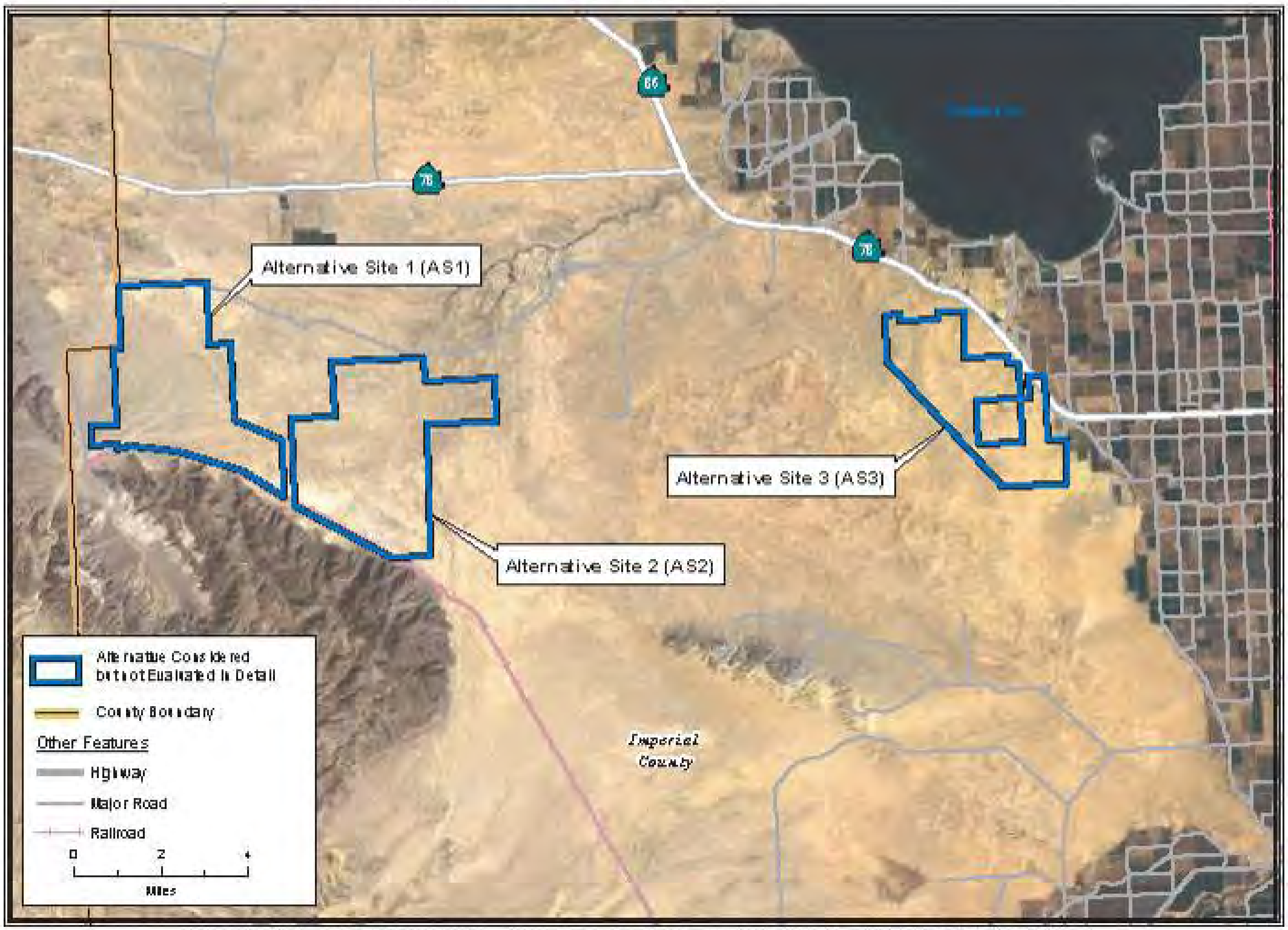
Attachment A – Maps of Off-Site Alternatives

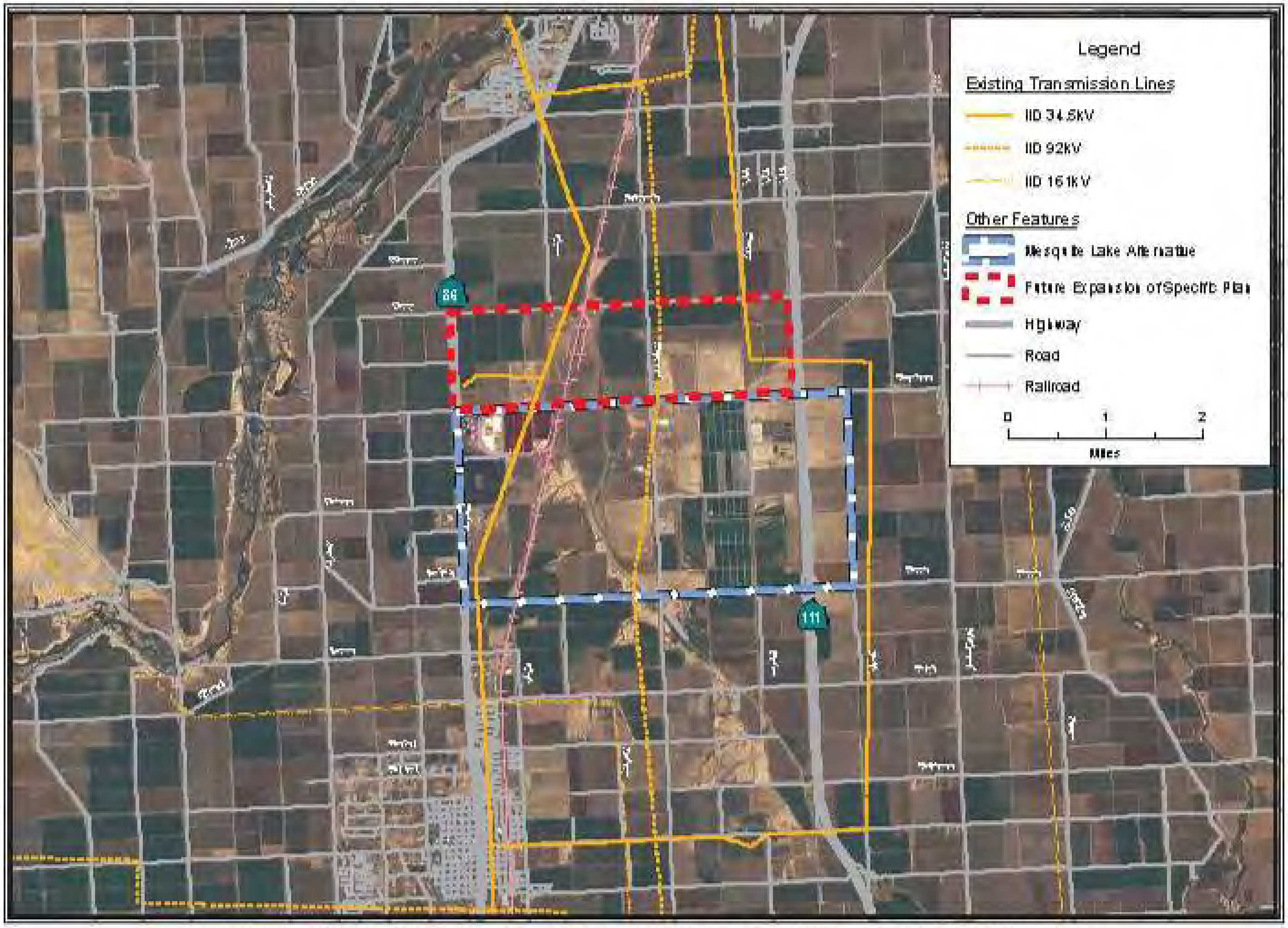
Figure 1. Locations for Alternatives AS-1, AS-2, and AS-3



CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION
SOURCE: SES 2008a

Figure 2. Mesquite Lake Alternative

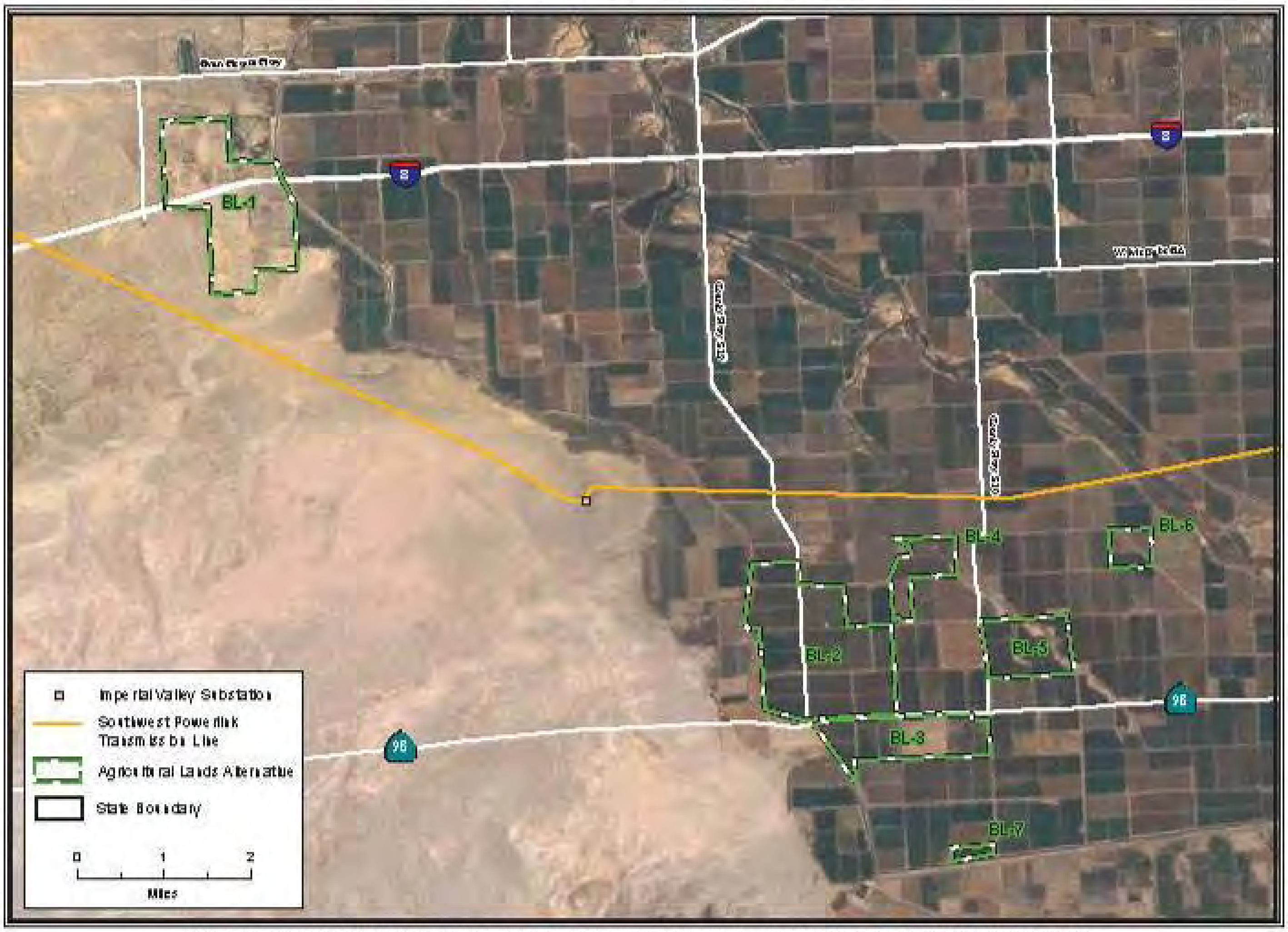
Imperial Valley Solar - Mesquite Lake Alternative



CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION
SOURCE: California Energy Commission

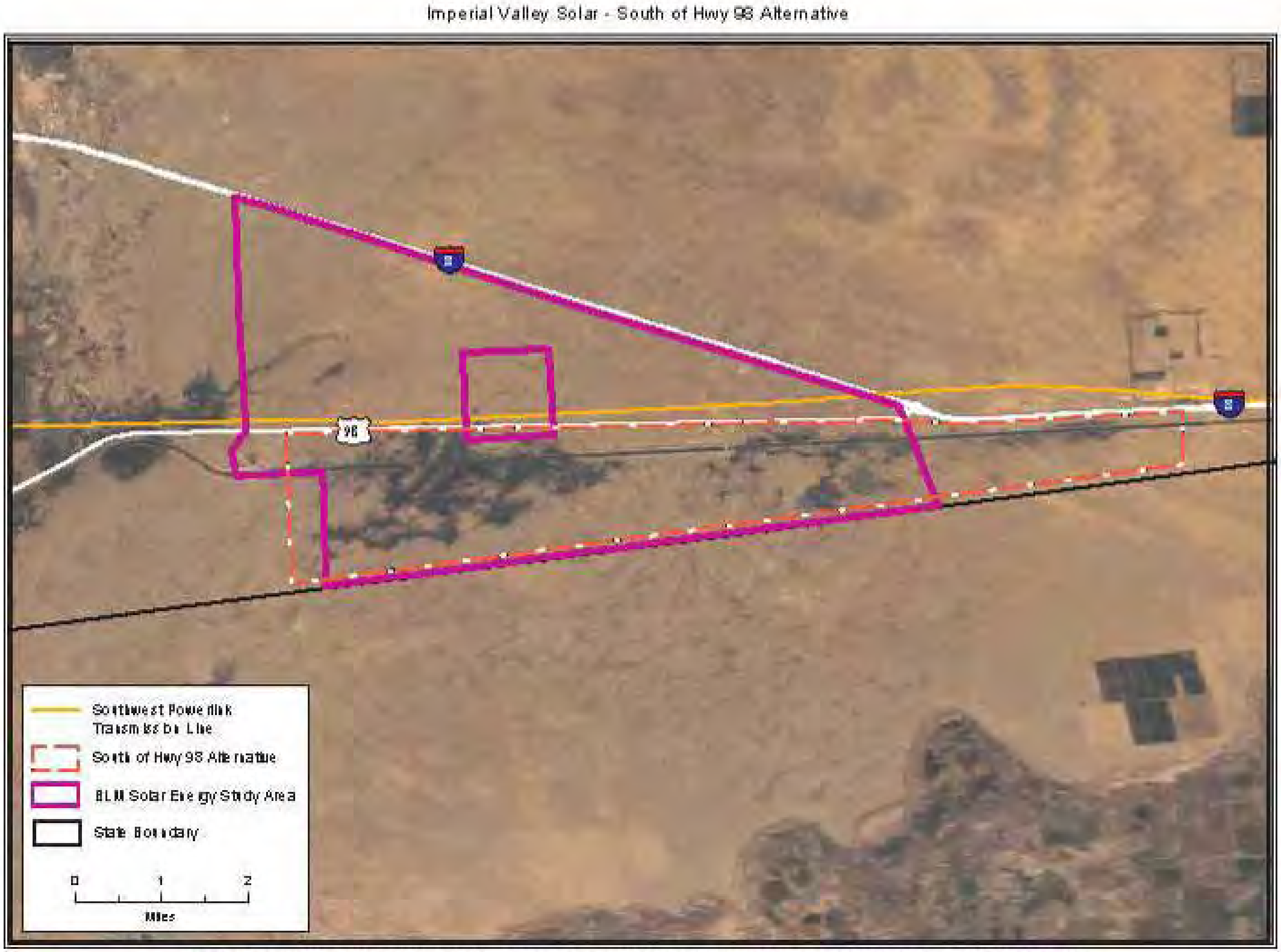
Figure 3. Agricultural Lands Alternative

Imperial Valley Solar - Agricultural Lands Alternative



CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION
SOURCE: California Energy Commission

Figure 4. South of Highway 98 Alternative

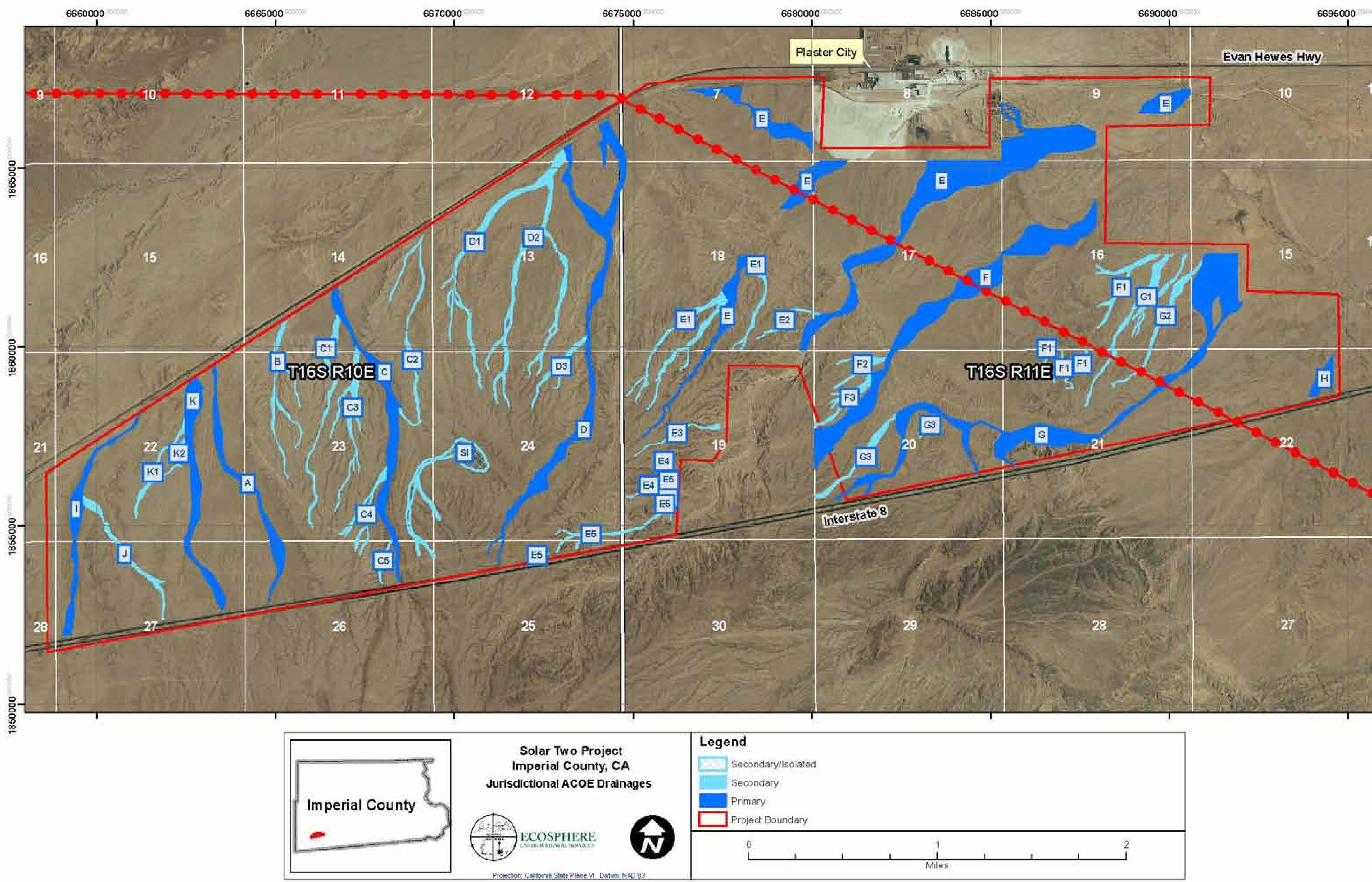


CALIFORNIA ENERGY COMMISSION - SITING, TRANSMISSION AND ENVIRONMENTAL PROTECTION DIVISION
SOURCE: California Energy Commission

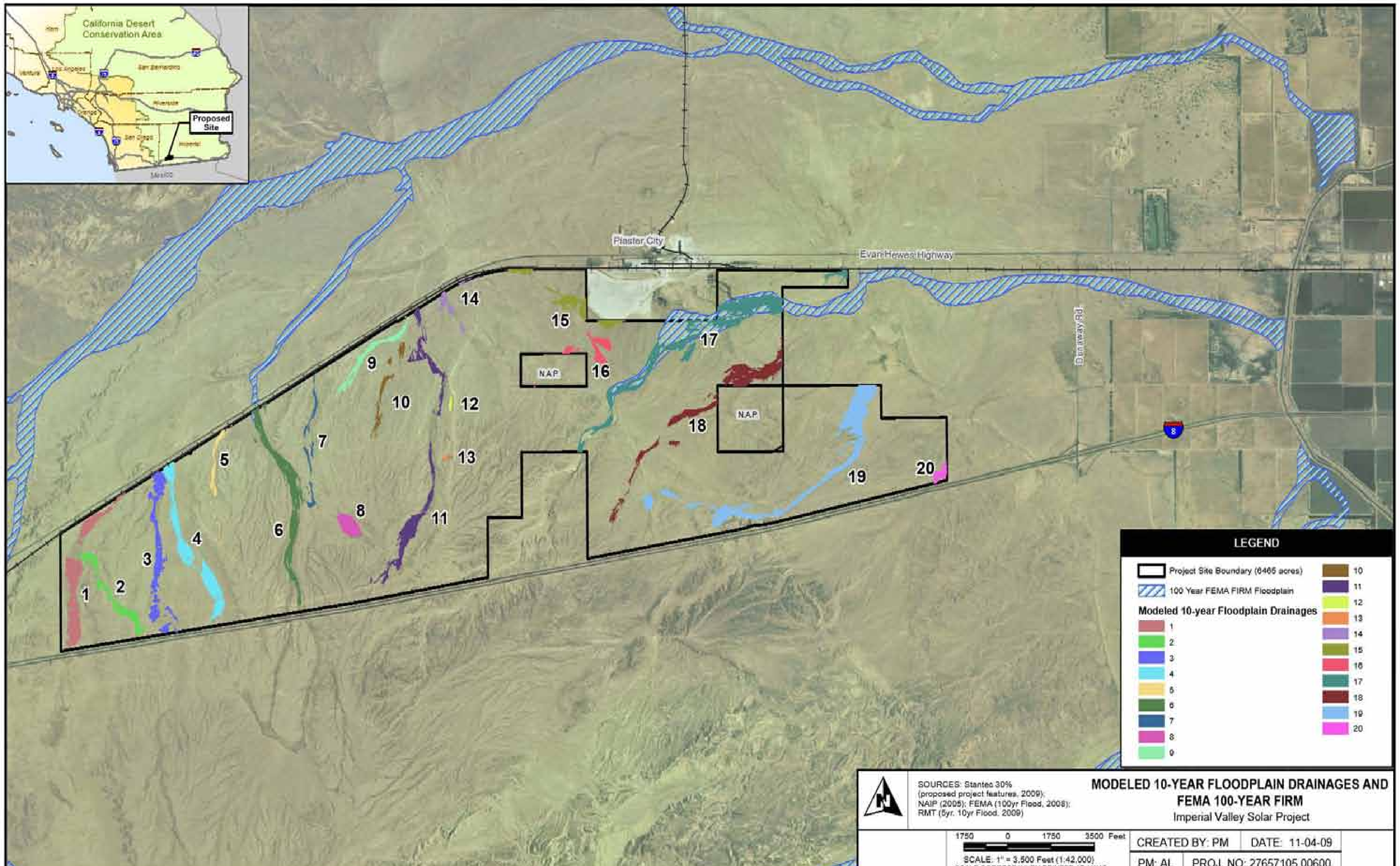
Attachment B – Maps of On-Site Alternatives

Map 1. Jurisdictional Waters of the U.S. on the Proposed Project site.
Map 2. 10-year floodplain map for the project area including FEMA 100-year floodplains.
Map 3. Site plan for Alternative # 1 – Applicant's Proposed Project.
Map 4. Site plan for Alternative #2 – Maximum Energy Generation Alternative.
Map 5. Site plan for Alternative #3 – Avoidance of the Highest Value Aquatic Resources Alternative.
Map 6. Site plan for Alternative #4 – Phase 1 Alternative.
Map 7. Site plan for Alternative #5 – Drainage Avoidance #1 Alternative.
Map 8. Site Plan for Alternative #6 – Drainage Avoidance #2 Alternative.

Map 1. Jurisdictional Waters of the U.S. on the Proposed Project site.



Map 2. 10-year floodplain map for the project area including FEMA 100-year floodplains.



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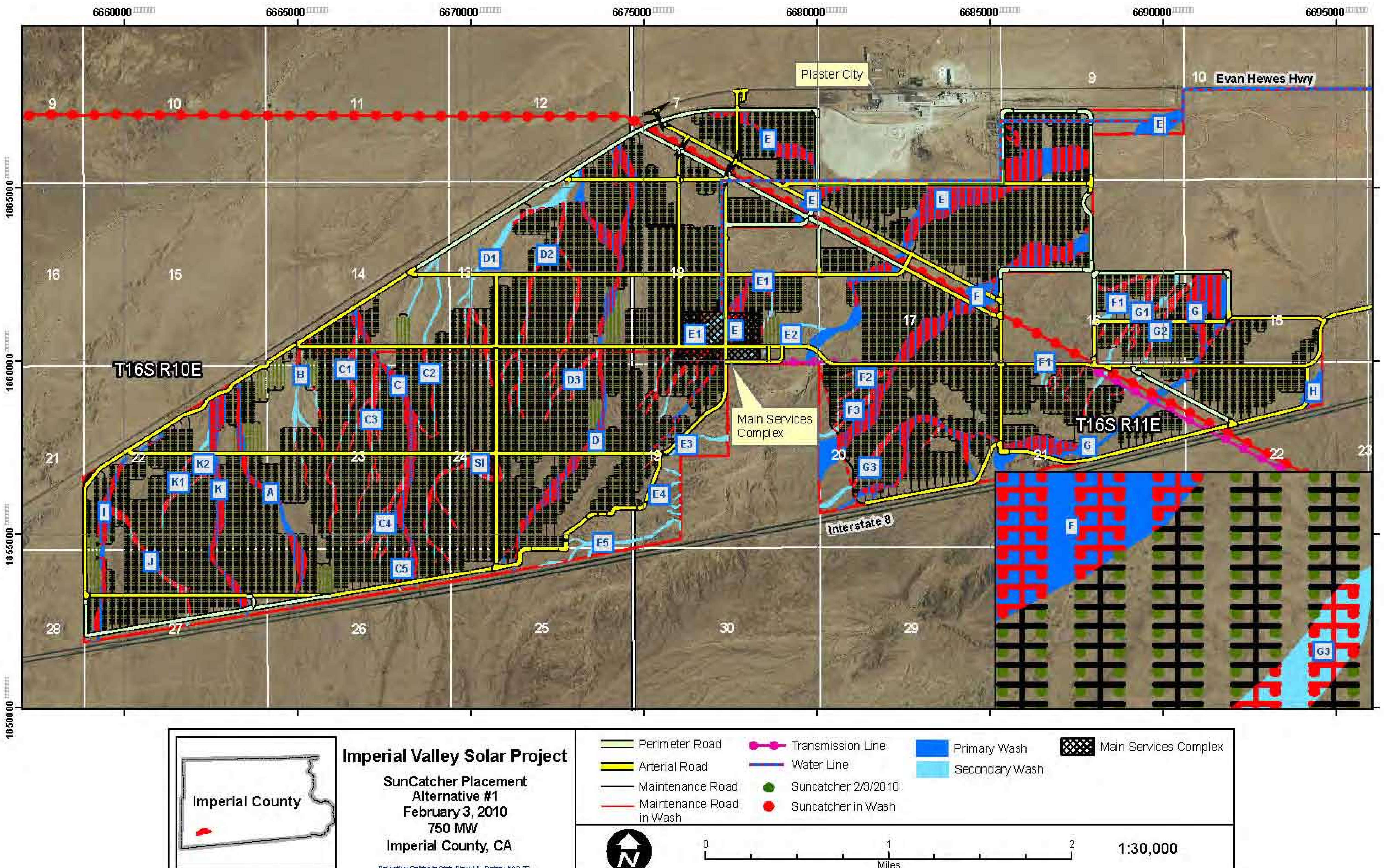
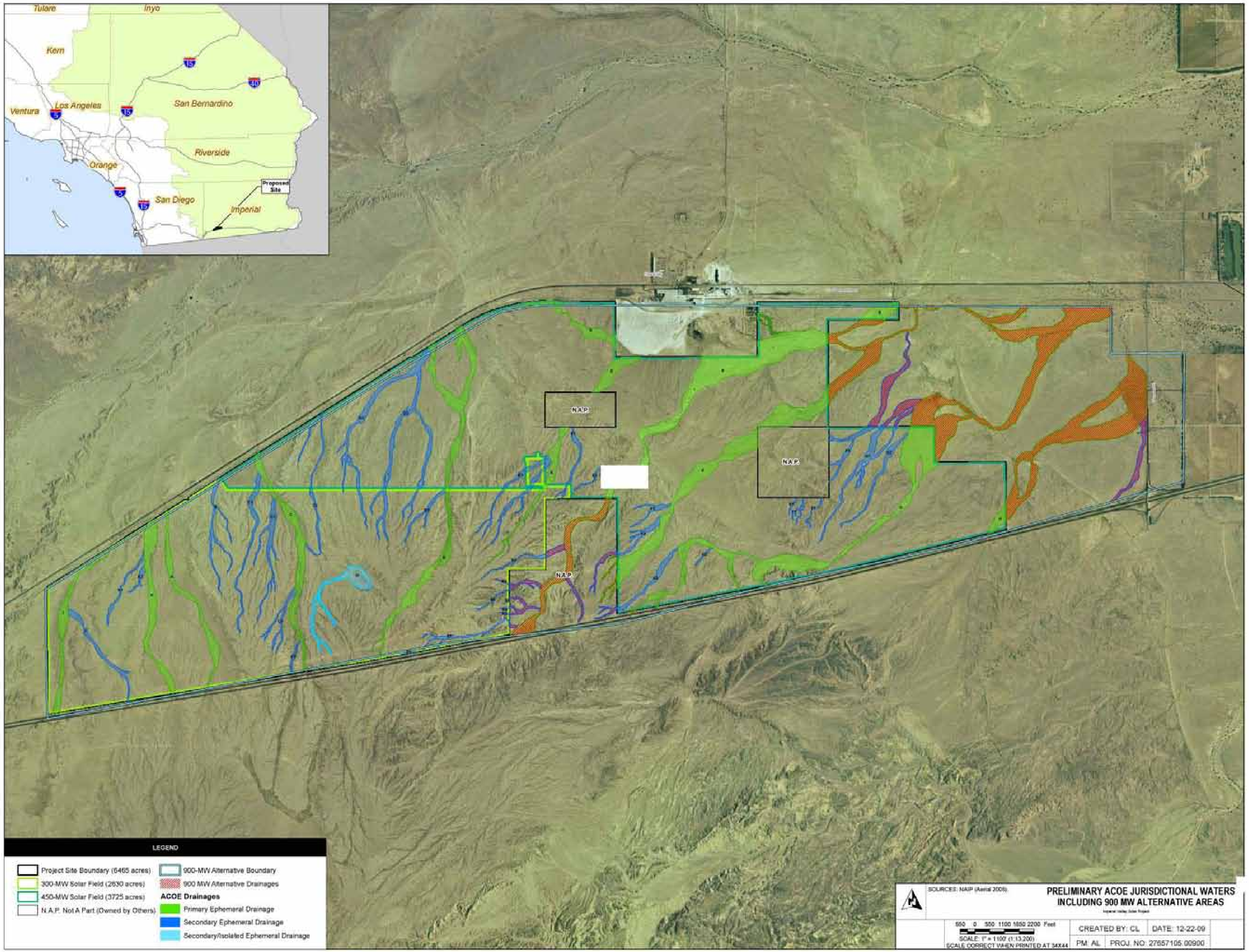
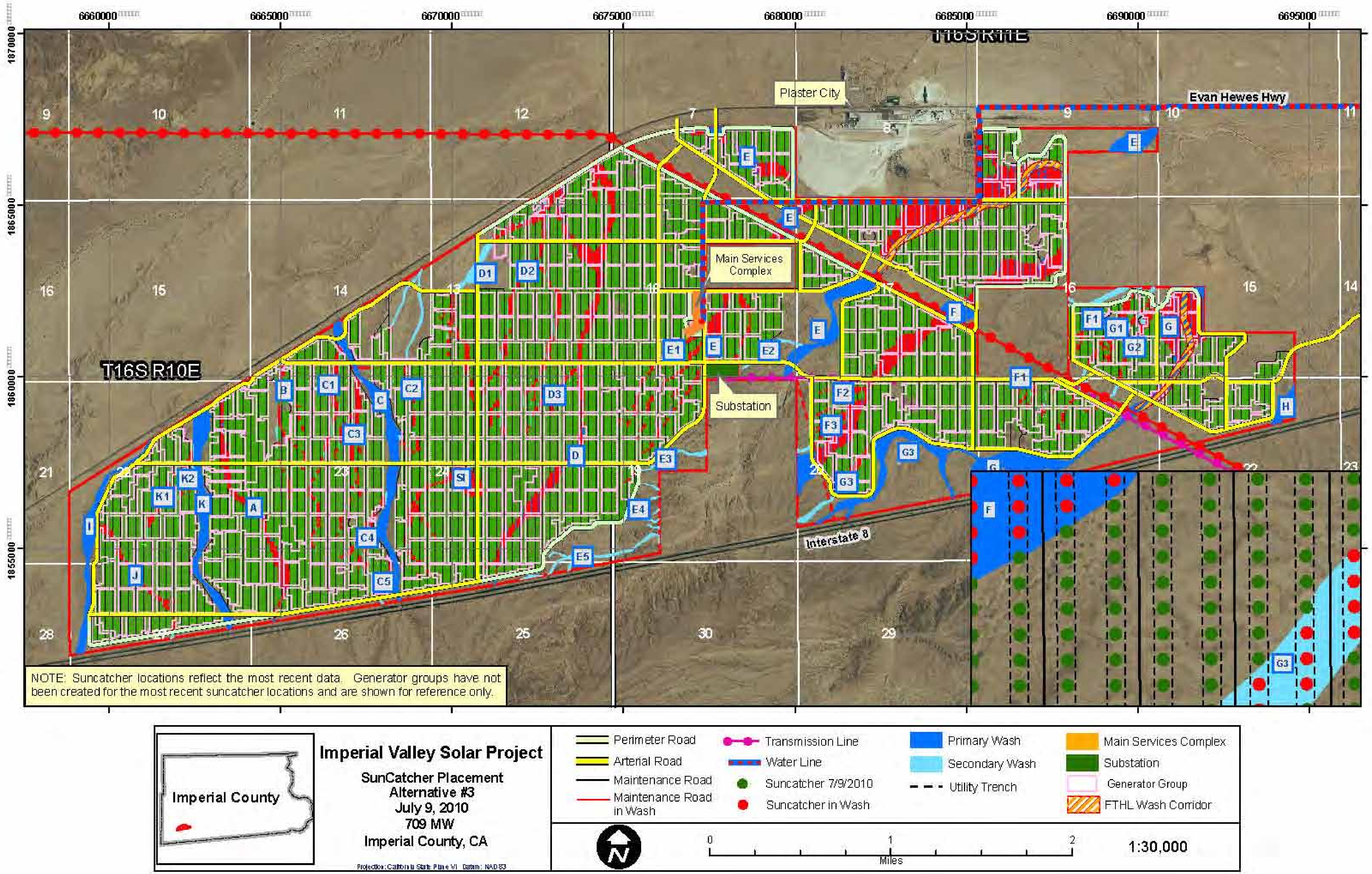
Map 3. Site plan for Alternative # 1 – Applicant's Proposed Project.



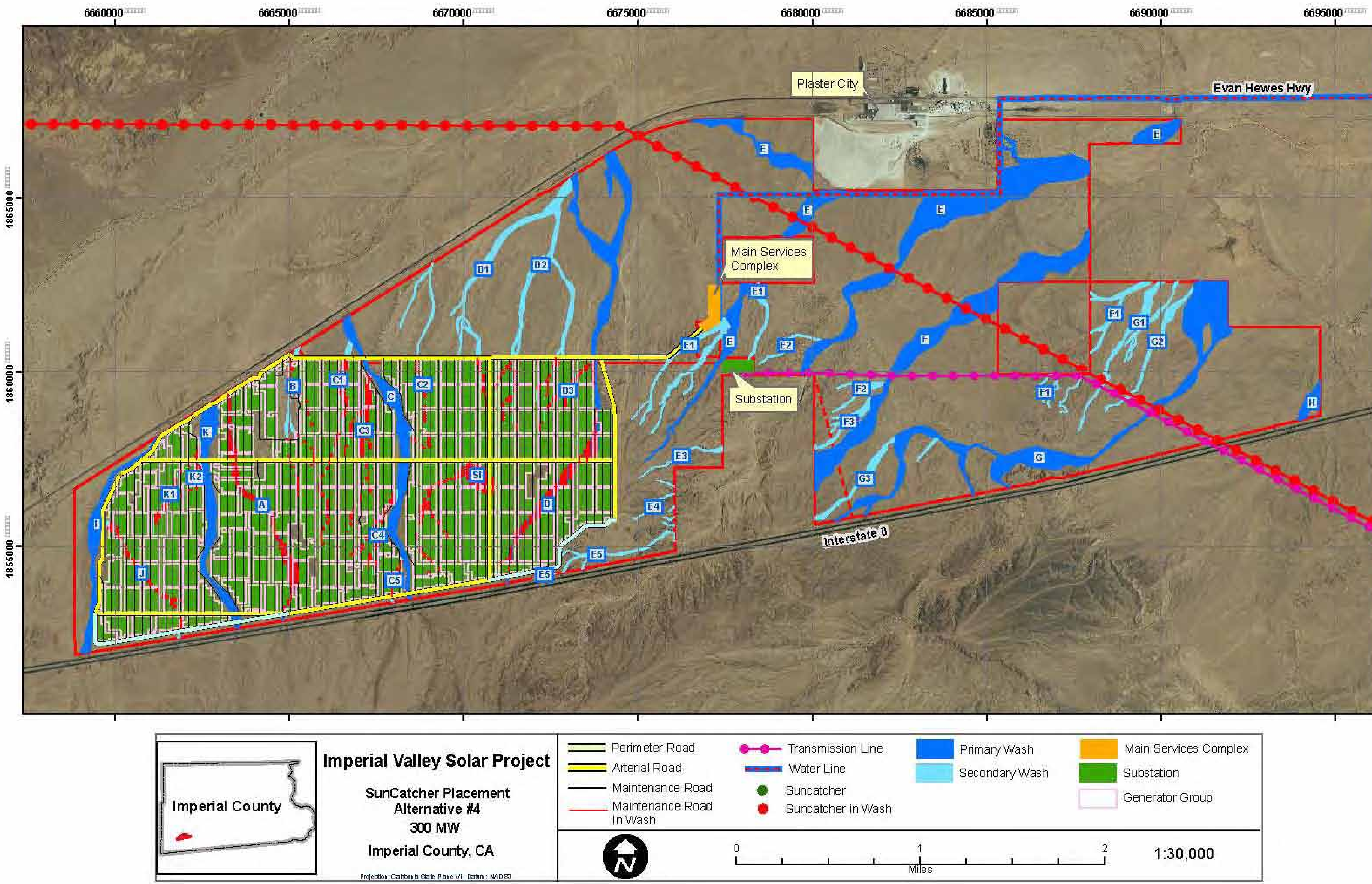
Map 4. Site plan for Alternative #2 – Maximum Energy Generation Alternative.



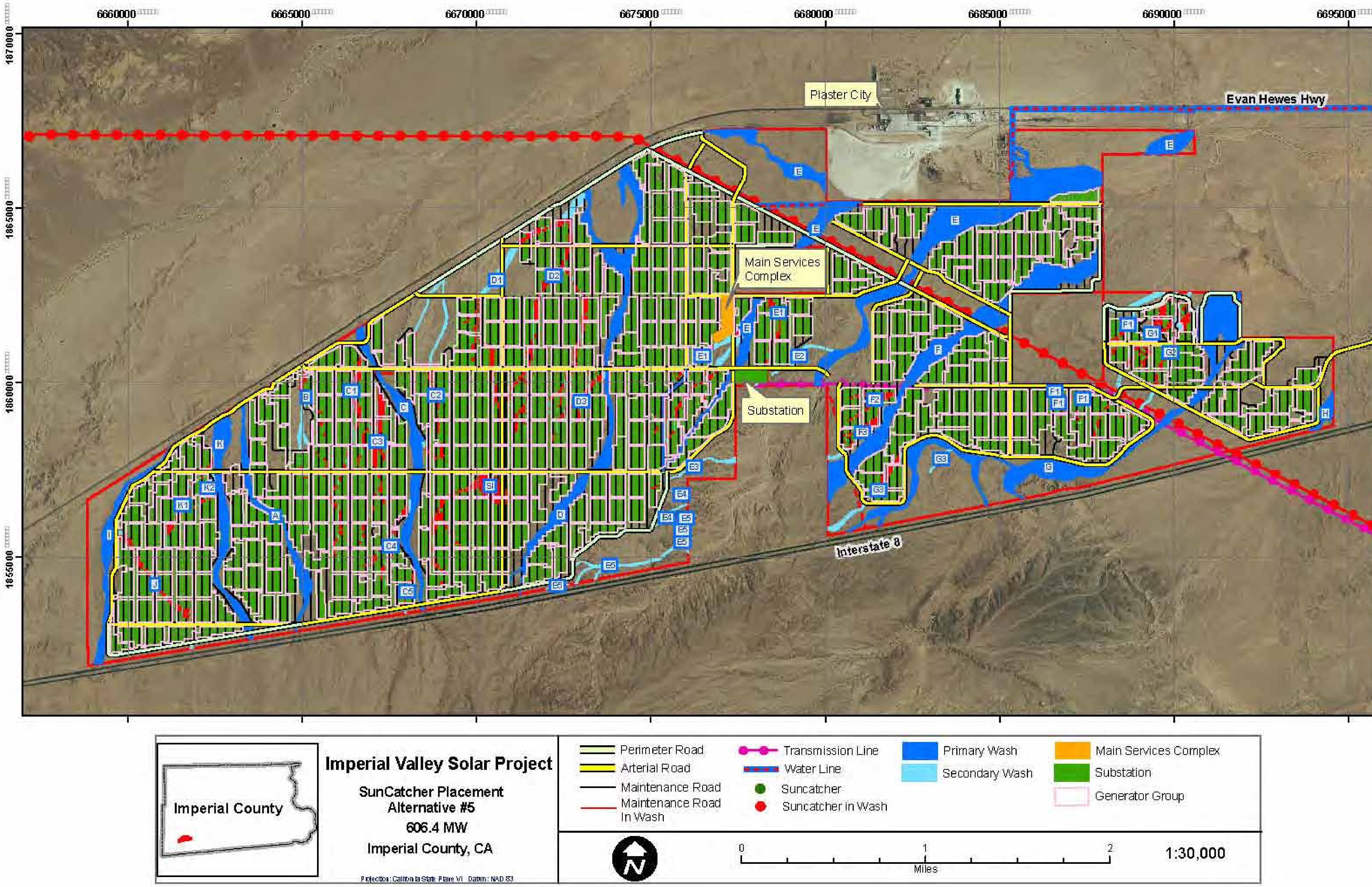
Map 5. Site plan for Alternative #3 – Avoidance of the Highest Value Aquatic Resources Alternative.



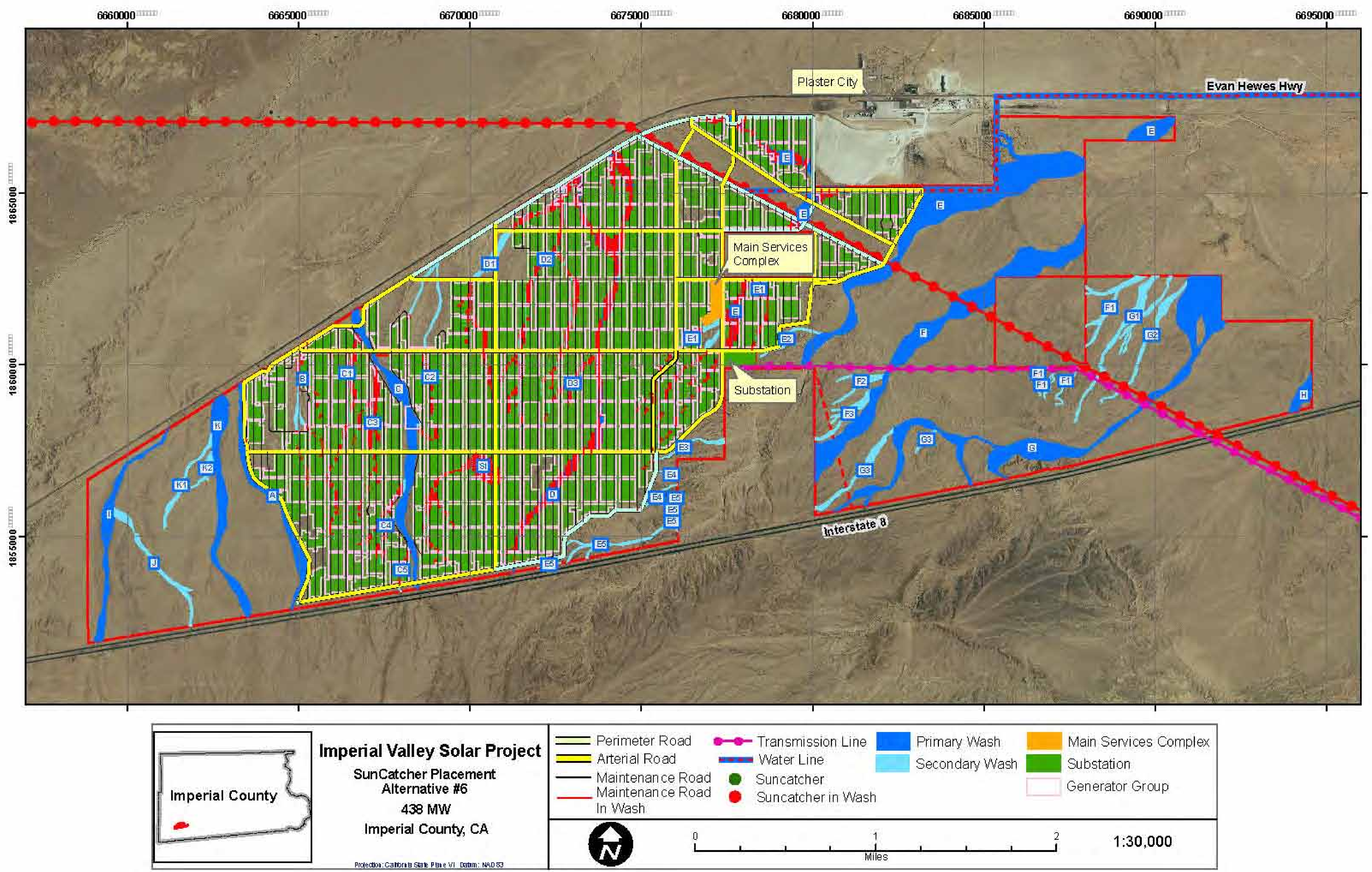
Map 6. Site plan for Alternative #4 – Phase 1 Alternative.



Map 7. Site plan for Alternative #5 – Drainage Avoidance #1 Alternative.



Map 8. Site Plan for Alternative #6 – Drainage Avoidance #2 Alternative.



Attachment C – Construction Diagrams

Diagram 1. At grade road crossing for ephemeral washes.
Diagram 2. Perimeter fence layout.
Diagram 3. Stormwater diversions around the substation building near the Main Services Complex.
Diagram 4. Layout of the perimeter fence with the spacing between posts.
Diagram 5. Fence post dimensions for corner posts and line posts.

Diagram 1. At grade road crossing for ephemeral washes.

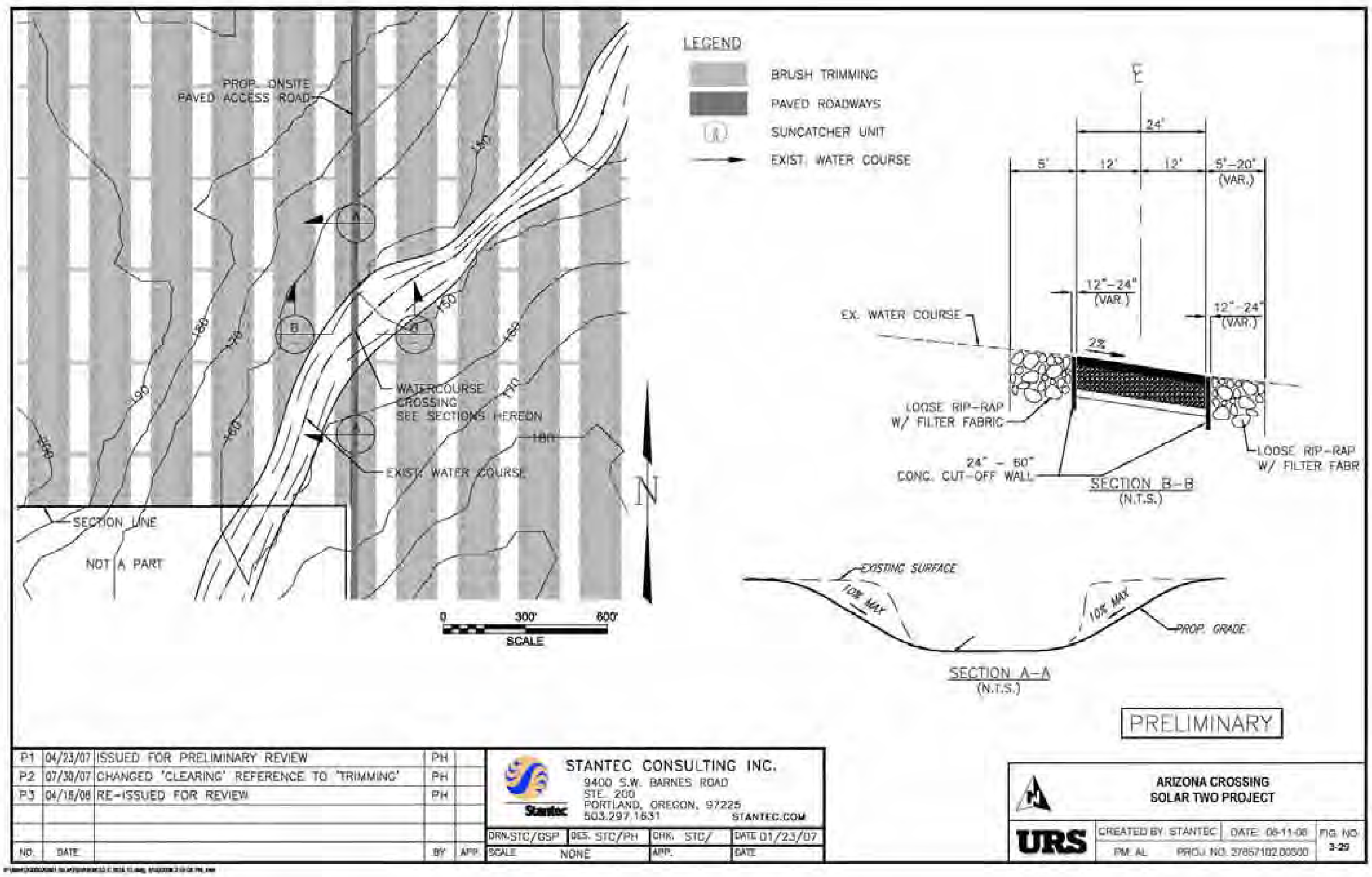


Diagram 2. Perimeter fence layout.

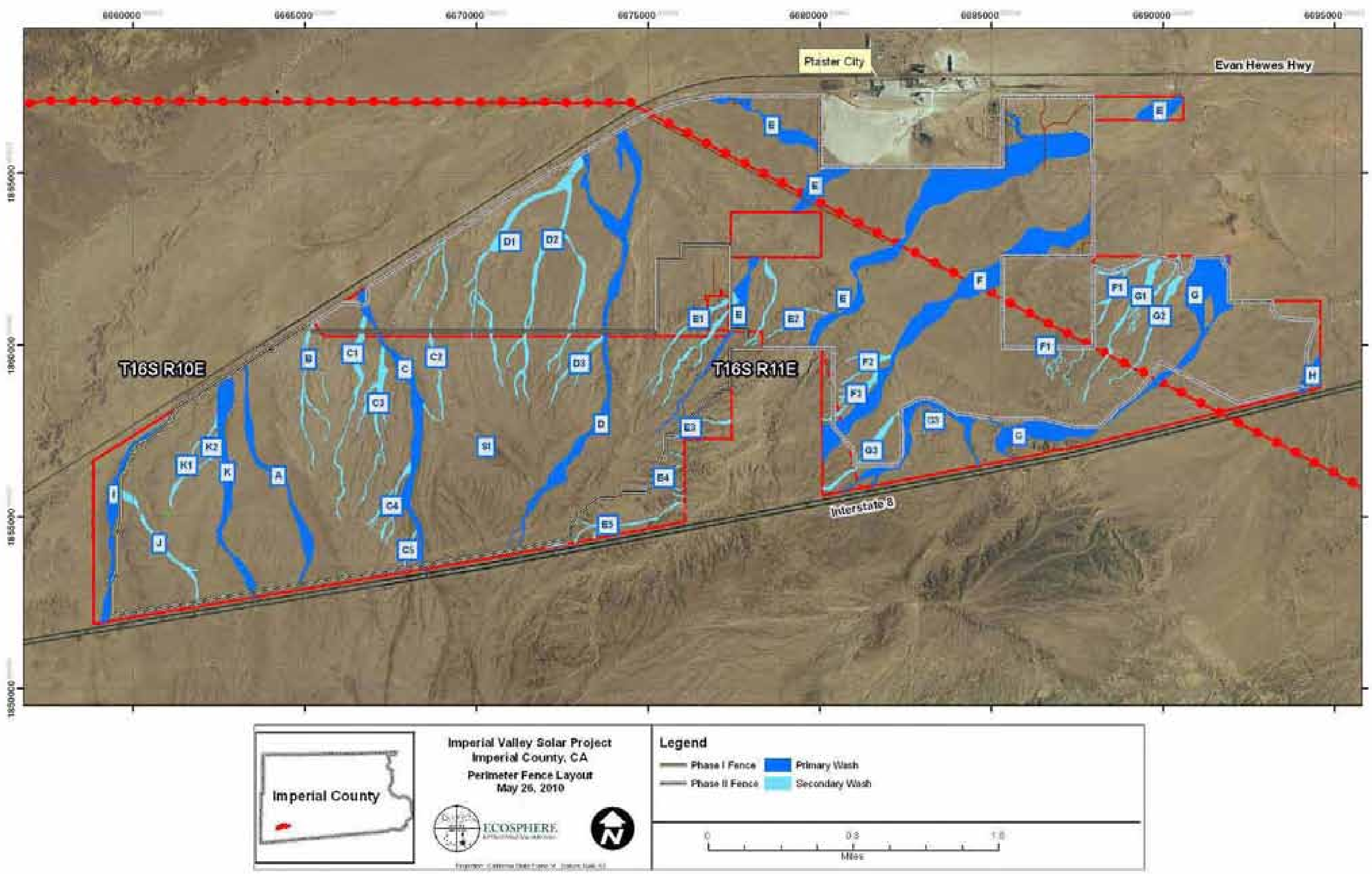


Diagram 3. Stormwater diversions around the substation building near the Main Services Complex.

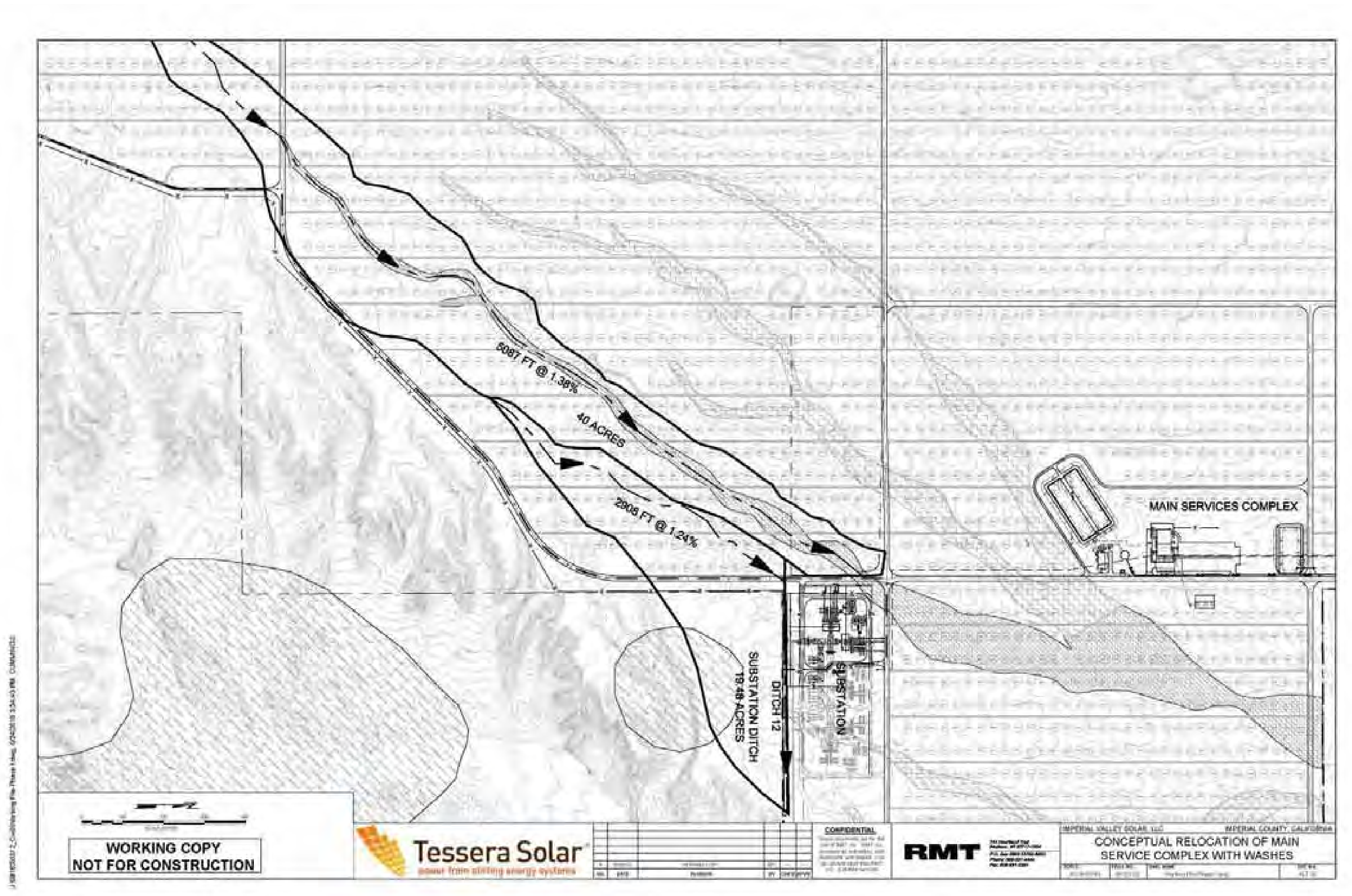


Diagram 4. Layout of the perimeter fence with the spacing between posts.

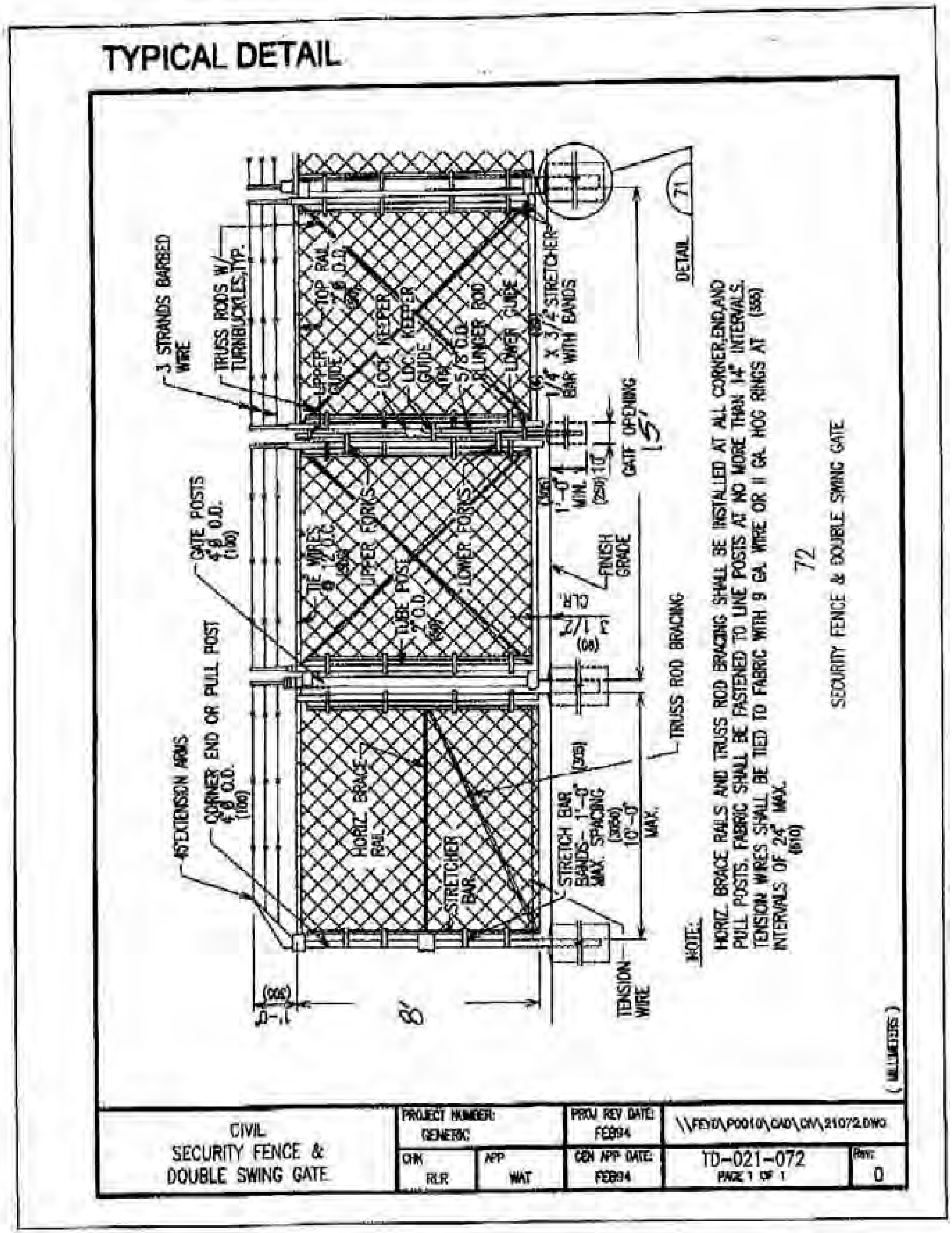
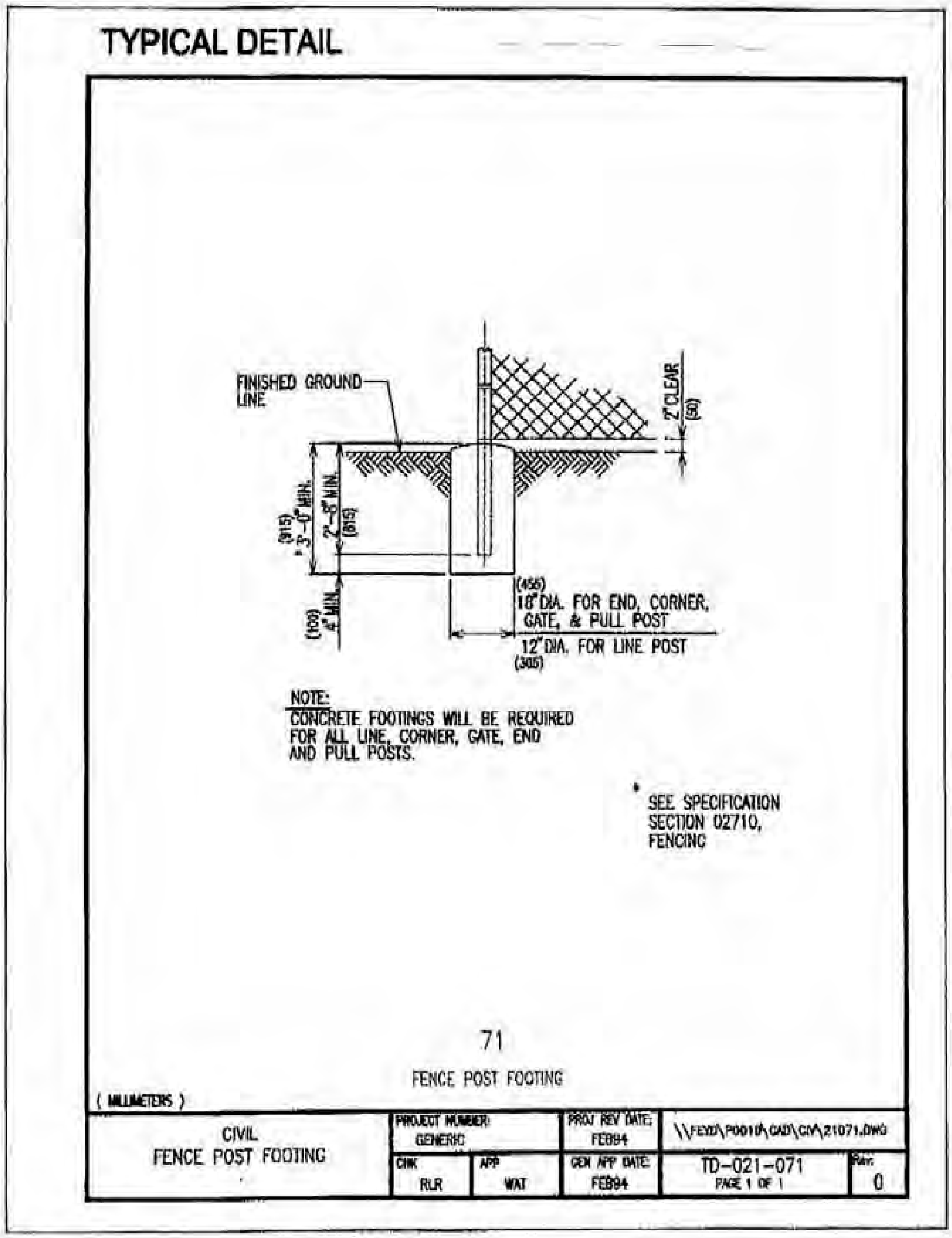


Diagram 5. Fence post dimensions for corner posts and line posts.



Attachment D – An Evaluation of the Application of the California Rapid Assessment Method (CRAM) for Assessment of Arid, Ephemeral Stream Condition

AN EVALUATION OF THE APPLICATION OF THE CALIFORNIA RAPID ASSESSMENT METHOD (CRAM) FOR ASSESSMENT OF ARID, EMPHEMERAL STREAM CONDITION: DRAFT TECHNICAL REPORT

Prepared for the U.S. Army Corps of Engineers, Los Angeles District

by the Southern California Coastal Water Research Project (SCCWRP)

June 2010

EXECUTIVE SUMMARY

This report presents the results of baseline research on the development a method to assess the ecological conditions of arid, ephemeral/intermittent streams. The Riverine Module of the California Rapid Assessment Method (CRAM) was used to assess the condition of ephemeral washes in an area of theYuha Desert, Imperial County, California. CRAM is an existing tool for assessing wetland functional capacity or condition throughout the State of California. It can be used as an initial diagnostic tool of general aquatic resource health and produces condition scores that are comparable and repeatable.

The results of this baseline study indicate that the theoretical construct of CRAM can be applied to arid, ephemeral streams, but certain metrics in the current Riverine Module will need to be recalibrated for these systems. The Landscape and Buffer Attribute can potentially apply to arid systems as currently constructed. The Hydrology Attribute performs reasonably well for arid systems, but some of the current indicators and field techniques will need to be revised in order to assess specific metrics. The Physical and Biotic Structure attributes were the two most problematic attributes to apply to a condition assessment of drainages in the study area.

This represents first phase of a long-term research effort to refine, modify, and validate the Riverine CRAM for application to ephemeral washes in desert regions of California. The results in this report should be applied only in the context of this project and should not be considered to address the larger question of assessment of arid, ephemeral stream courses. Future efforts will involve a broader technical team and thorough stakeholder review processes.

INTRODUCTION

Arid-land fluvial systems dominate the stream types of the arid southwestern United States (Lichvar and Wakeley 2004). These systems are characterized by unique hydrologic and geomorphic attributes that distinguish them from their counterparts in more humid, temperate regions and limit the application of current hydraulic models to describe these systems. These characteristics include:

- Highly localized and extremely variable flow;
- Substantially greater flood magnitudes (as a multiple of average flow);
- Strong interactions with shallow groundwater, notably rapid infiltration and decreasing flow downstream;
- Episodic movement of sediment;
- Transient forms that confound conventional notions of stable and unstable channel form as well as determinations of active versus relict stream processes.

The majority of streams located in arid regions are classified as intermittent and ephemeral. Intermittent streams depend on water from springs or surface runoff, whereas water flow in ephemeral streams feeds groundwater, and, therefore, they only flow during and immediately after storm events, except in areas where stream channels are used to divert and/or disseminate seasonal irrigation (Gordon et al. 2004, Levick et al. 2008).

Despite the episodic nature of surface flow, arid land stream systems are recognized as critically important environments that provide valuable ecological benefits by conveying floodwaters and helping to ameliorate flood damage; maintaining water quality and quantity; ensuring sediment continuity with downstream areas; providing habitat for plants, aquatic organisms, and wildlife; and contributing to the ecological productivity of downstream environments (Brinson et al. 1981; Davis et al. 1996; Meyer et al. 2003). Rapid urbanization and other forms of development in arid and semi-arid landscapes threaten the integrity of these systems. Modification or elimination of arid land streams can severely affect baseflows, groundwater recharge, and the biological communities adapted to the natural hydrology and distributary stream networks. Hydrological modifications to such channels can concentrate flows, increase flood intensities, and increase sediment transport and erosion, although the effects of such modifications may not manifest for years or even decades until the next flash flood event.

Because more attention has historically been given to streams located in mesic, coastal areas, appropriate methodologies for assessing the condition of arid land stream systems are lacking. Given the increasing demands being placed on arid land waterways, it is imperative that California develops the capacity to assess the condition of these systems that takes into account their unique physical and ecological processes.

The California Rapid Assessment Method

The State and Federal agencies that comprise the California Wetlands Monitoring Workgroup (CWMW)[1] are promoting the use of rapid assessment methods (RAMs) as a core tool to evaluate aquatic resource condition. Currently, the most widely used wetland rapid assessment in the state is the California Rapid Assessment Method (CRAM; www.cramwetlands.org). CRAM is intended to provide a rapid and repeatable assessment method that can be used routinely for wetland monitoring and assessment throughout the State of California. It provides consistent and comparable assessments of wetland condition for all wetlands and regions in California, yet accommodates special characteristics of different regions and types of wetlands. The CRAM typology currently recognizes six major wetland types, four of which have subtypes (Table 1). For the purposes of CRAM, *condition* is defined as the state of a wetland assessment area's physical and biological structure, the hydrology, and its buffer and landscape context relative to the best achievable states for the same type of wetland. Condition is evaluated based on observations made at the time of the assessment, the results of which can be used to infer the ability to provide various functions, services, values and beneficial uses to which a wetland is most suited (Collins et al. 2008), although these are not

[1] The CWMW is a subcommittee of the California Water Quality Monitoring Council (Senate Bill 1070; Kehoe, 2006),

measured directly by CRAM. CRAM also identifies key anthropogenic stressors that may be affecting wetland condition.

Table 1: The CRAM Wetland Typology. Table shows wetland types for which CRAM modules currently exist. (future versions of CRAM may add additional wetland types or subtypes).

CRAM Wetland Types	***CRAM Sub-types (these are recognized for some but not all metrics)***
Riverine Ecosystems	Confined Riverine Ecosystems
	Non-confined Riverine Ecosystems
Depressional Wetlands	Individual Vernal Pools
	Vernal Pool Systems
	Other Depressional Wetlands
Estuarine Wetlands	Perennial Saline Estuarine Wetlands
	Perennial Non-saline Estuarine Wetlands
	Seasonal Estuarine Wetlands
Playas	no sub-types
Slope Wetlands	Seeps and Springs
	Wet Meadows
Lacustrine Wetlands	no sub-types

CRAM was developed through the joint efforts of an interregional team of scientists from the Southern California Coastal Water Research Project (SCCWRP), the San Francisco Estuary Institute (SFEI), Moss Landing Marine Laboratories (MLML), and U.C. Davis. The method has undergone extensive technical review and iterative refinement for all CRAM wetland types. In addition, the riverine and estuarine classes have been validated against independent, more intensive measures of condition including benthic invertebrates, riparian birds, and estuarine plant richness and diversity (Stein et al. 2009). This has resulted in refinement of the metrics for these wetland types and provides for a higher level of confidence in the ecological meaning of CRAM scores. CRAM testing, validation, and implementation are coordinated on an ongoing basis by the RAM Subcommittee of the CWMW.

CRAM can be used as an initial diagnostic tool of general aquatic resource health and produces condition scores that are comparable and repeatable. The method is most effective when used as directed by trained professionals in a comprehensive aquatic resource-monitoring program that includes accurate mapping of aquatic habitats and traditional, intensive methods of ecological assessment. Intensive assessment is the quantification of selected processes or health aspects of aquatic areas. It is essential to answer questions about particular plant and animal species, water quality parameters, or other condition aspects that are not individually assessed using RAMs.

CRAM is intended for application to all kinds of wetlands throughout California and method validation efforts have indicated that CRAM is broadly applicable throughout the range of conditions commonly encountered (Stein et al. 2009). However, because CRAM emphasizes the functional contribution of structural complexity, the current version of the method has the potential to yield artificially low scores for wetlands that do not naturally appear to be structurally complex. This includes low order, ephemeral streams in the headwater reaches of very arid watersheds not to support species-rich plant communities with complex horizontal and vertical structure. CRAM may be systematically biased against such naturally simple systems and it is recognized that this may represent a limit to the method's applicability. For this reason, refinement of some of the CRAM metrics for these subclasses of wetlands may be needed to more appropriately assess these wetland types. The need for concurrent intensive assessment is particularly needed for arid and/or ephemeral fluvial systems where the expected physical and biological conditions may deviate from those used at the sites used to validate CRAM. Inclusion of ancillary data provides added depth and detail to the condition assessment and can serve to further validate and/or refine CRAM for such systems.

PROJECT OBJECTIVES AND GOALS

The overall goal of this effort was to support the continued development and refinement of CRAM and improve its performance and validity in arid land fluvial systems. Specific outcomes related to this effort included:

- Evaluation of the current version of the CRAM Riverine Module for applicability to arid, ephemeral streams
- Collection of baseline condition data to inform upon the refinement and/or modification of the current method;
- Explorations of appropriate ancillary indicators of condition that can be used to validate CRAM for arid systems.

METHODS

Study Site

The study site is located in the southwestern corner of Imperial County (approximately 100 miles east of San Diego, 14 miles west of El Centro, and 4 miles east of Ocotillo Wells) in the Sonoran (Yuha) Desert. It is sited on approximately 6,140 acres of federal land that is administered and managed by the Bureau of Land Management (BLM). The site is comprised of mostly of undeveloped desert land, although approximately 1,039 acres of dirt and off highway vehicle (OHV) roads traverse the site. There are approximately 360 acres of privately owned land (two private parcels; one owned by a recreational vehicle club and one by a private entity) that are surrounded by the project site, but are not a part of the project. Immediately adjacent to the southern boundary of the project site is the Yuha Area of Critical Environmental Concern under BLM jurisdiction. The closest communities to the project site are Edgar and Coyote Wells, located approximately 5 miles east and 4 miles west, respectively.

The region in which the project is located receives an average annual precipitation of 2.65 inches (WRCC data). Rainfall occurs primarily from December to March in the form of widespread winter storms. Approximately 53% of total yearly rainfall occurs during those months. The wettest month of the year is December with an average rainfall of 0.42 Inches Summer monsoon storms generally occur from August to October, when approximately 34% of total yearly rainfall occurs. There is very little precipitation during the months of April to July (about 6% of the yearly total).

The study site is characterized by alluvial sediments formed from alluvial fans that gradually slope to the northeast. Ground elevations range from 300 ft on the southwestern area of the site to seal level on the northeastern side. The western portion of the site has a rolling terrain with well-defined washes, whereas the eastern portion has more uniform, gentle slopes and wider, shallow, less-defined washes. The soil within the washes has been mainly deposited by fluvial action, tends to be uniformly sorted, and varies from silt to loose, fine sand. In upland areas not subject to concentrated water flows, the soil is more densely compacted and often contains larger gravel and cobbles. Outcrops of sand/siltstone are common in some of these areas.

The numerous drainages that traverse the site are ephemeral and only convey flows following a substantial rainfall. Headwaters for these drainages are located in gently sloping upland areas located to the south and west of the study site. Culverts under the Interstate 8 Freeway allow flows from south of the freeway to flow beneath the highway and into the study area boundary. The ephemeral washes on the western edge of the site drain north of the site; washes in the center of the site also drain north, but are also estimated to return flow towards the northeastern portion of the site; the ephemeral washes on the eastern half of the site drain east across the site (Appendix 1). All channel flow exits the site beneath Evan Hewes Highway and the railroad track located on the northern boundary.

The vegetation community of the washes is classified as Sonoran creosote bush scrub, but they also contain sparse stands of mesquite and tamarisk (SES 2008a). The washes generally contain a greater vegetative diversity and density than the creosote bush scrub habitat outside of the washes (SES 2009s). The site supports a diversity of mammals, birds, and reptiles, including some special status wildlife species, including the burrowing owl and the flat-tailed horned lizard.

CRAM Framework, Scoring, and Score Interpretation

CRAM assesses four overarching attributes of wetland condition: landscape context, hydrology, physical structure, and biotic structure. Within each of these attributes are a number of metrics (10 total) that assess more specific aspects of wetland condition (Table 2). In addition to producing a condition score, CRAM also includes a stressor checklist to help explain the scores and to identify possible management actions to improve condition. A description of these attributes and their corresponding metrics are provided in the results section of this report. Collins *et al.* (2008) provides a detailed description of the method.

Table 2. Relationship between CRAM attributes and metrics/submetrics. The four attributes are averaged to produce an overall CRAM index score.

Attribute	Metric
Buffer and Landscape Context	Landscape Connectivity
	Buffer:
	Percent of AA with Buffer
	Average Buffer Width
	Buffer Condition
Hydrology	Water Source
	Hydroperiod
	Hydrologic Connectivity
Physical Structure	Structural Patch Richness
	Topographic Complexity
Biological Structure	Plant Community:
	Number of Plant Layers Presents
	Number of Co-dominants
	Percent Invasion
	Horizontal Interspersion and Zonation
	Vertical Biotic Structure

The fundamental unit of evaluation for CRAM assessments is termed the Assessment Area (AA). The AA is the portion of the wetland that is assessed using CRAM. To conduct a CRAM assessment, each of the metrics is evaluated for an AA in the field to yield a numeric score for an assessed wetland based either on narrative or schematic descriptions of condition or on thresholds across continuous values. Metric descriptions are based on characteristics of wetlands observed across a gradient of reference conditions for each wetland type evaluated (Smith *et al*. 1995). Choosing the best-fit description for each metric generates a letter grade for each attribute. Metric and attribute scoring in CRAM was developed such that the incremental increase in condition associated with moving from one category to the next higher category is the same across metrics and attributes; that is, an increase from category D to category C is proportionally the same as an increase from category B to category A. These letter grades are converted to numeric scores by assigning the following values: A= 12, B= 9, C=6, D=3. Metric scores under each attribute are aggregated in CRAM to yield scores at the level of attributes, and attribute scores are aggregated to yield a single overall index score, via simple arithmetic formulas. Attribute and index scores are expressed as percent possible, ranging from 25 (lowest possible) to a maximum of 100.

Individual CRAM metric scores, attribute scores, and overall AA scores are based on an internal reference standard that represents the best achievable condition statewide for the type of wetland being assessed. Therefore, any two scores for the same type of wetland can be compared to each other because they are based on the same statewide standard. For example, an Assessment Area having a score of 50 can be interpreted as having lower ecological condition than another AA of the same wetland type having an AA score of 80. A similar interpretation can be made for Attribute scores.

A repeatability analysis conducted during the CRAM calibration/validation process for riverine systems and estuarine wetlands revealed that Attribute scores and overall AA scores have less than 10% error due to differences in practitioners, with the error rate being less for Attribute scores than overall AA scores. This suggests that the precision of CRAM Attribute scores and AA scores for riverine systems and estuarine wetlands is about 10%, or about 10 CRAM points for the AA score (i.e., 10% of the possible 100 points for an AA), and about 5 points for the Attribute scores. Differences in AA scores of 10 CRAM points or less are within the error of the method and therefore should not be considered to represent differences in overall condition. Similarly, two scores for the same Attribute that differ by less than 5 CRAM points should not be regarded as representing differences in condition.

Study Design

Ephemeral washes were assessed from March 22-April 2, 2010 with the current version of the CRAM Riverine Module. All assessments adhered to recommended maximum and minimum assessment area sizes and specific guidance for assessment of projects from the CRAM User's Manual version 5.02 (Collins et al. 2008) and the CRAM Technical Bulletin (CWMW 2009). Because there are 878 acres of primary and secondary ephemeral streams (~225 thousand linear feet) associated with the study area (Appendix 2), CRAM assessment site locations were probabilistically selected. A map of all possible sampling locations was produced; from this list a subsample of locations were selected for the CRAM assessments. Sampling sites were selected so that CRAM assessment areas would represent unique reaches of stream channels to cover a diversity of channel types, sizes, and stream orders. Of the 90 potential CRAM assessment sites probabilistically selected (Appendix 3), 84 of these were assessed with CRAM.

For each CRAM assessment, initial office work included acquisition of site imagery, logistical planning for the site visit, and assembly background information about the site to be assessed and its possible stressors. Previously completed assessments of biology, hydrology, soils, geology, and other data for the study site were used to support this phase of the assessment.

Because of the close association between riparian vegetation and stream hydrology (Lichvar and Wakeley 2004), intensive vegetation data were collected at a subset of sites at the time of the CRAM assessments. The point intercept method was used by walking along a transect tape placed across the CRAM assessment area (perpendicular to the stream channel) and recording the number of "hits" of vegetation (percent cover and species richness was only assessed for plants growing in the channel and active floodplain). Using this method, total cover of plant species was calculated as the percentage of hits, relative to the total number of points sampled. Cover of individual species was also estimated by recording the plant species when intercepted by a point.

In addition, ancillary hydrologic and geomorphic indicators e.g. physical/structural patch type data were also collected opportunistically at CRAM assessments areas. These data were used to both inform upon the CRAM condition assessments and contribute to a longer-term effort of refining and validating CRAM for future applications in arid and desert regions of the State. These data included documentation of different or new patch types observed at each site as well as the exploration of alternative ways to describe and document indicators of channel stability and hydrologic connectivity to better characterize arid systems.

Analysis

Information from the previously completed reports on the biology, hydrology, soils, and geology for the project site were synthesized to provide an overall evaluation of the site for the office portion of the CRAM assessments. CRAM scores (Attribute and Overall scores) were summarized with descriptive statistics. The results are displayed graphically and in tabular format. Vegetation transect data was summarized in tabular format. CRAM Index scores were compared with the results of the plant survey data using linear regression. Because there is insufficient data available at this time to describe the statistical distribution of metric scores, of their averages, or of the Attribute scores and overall AA scores calculated from the average metric scores, these data were not statistically analyzed using any parametric procedures.

RESULTS

A total of 84 stream sites within the study site were assessed with CRAM (Appendix 4; Appendix 5a-b). None of the sites contained flowing surface water at the time of the CRAM assessment. All sites were classified as unconfined riverine systems (i.e. the width of the valley across which the system can migrate without encountering a hillside, terrace, or other feature that is likely to prevent further migration is at least twice the average bankfull width of the channel).

Most of the primary sites assessed were compound ephemeral channels. Compound ephemeral channels (Lichvar et al. 2009; Lichvar and McColley 2008) are characterized by a mosaic of terraces within a wide, active floodplain by a single, low-flow meandering channel inset into a wider braided channel network and mosaic of terraces (Graf 1988a). These channels are highly susceptible to widening and avulsions (channel relocation) during moderate to high discharges, reestablishing a low-flow channel during subsequent low flows (Lichvar et al. 2009; Lichvar and McColley 2008).

Figure 1. Examples of compound ephemeral channels on the study area.

A smaller number of the secondary drainages assessed were discontinuous ephemeral streams (Lichvar et al. 2009; Lichvar and McColley 2008; Figure 2). Discontinuous ephemeral streams are characterized by alternating erosional and depositional reaches. They are constantly in flux, as headcuts (knick points) originating at the downstream end of the sheetflood zone migrate upstream, causing dramatic temporal and spatial changes in channel morphology for any given location.

Figure 2. Examples of discontinuous ephemeral channels on the study area.

A high density of closely spaced braided channels with high width-to-depth ratio and low sinuosity generally characterize the larger drainages on the study site. Most of the channels encountered tended to have deep sediments composed of sands and gravels, with widely scattered vegetation growing within the channel and its floodplain. Headwater drainages on the site are characterized by some gullying and “badland” development. High width-to-depth ratios, braided channels and low sinuosity are often the result of high sediment concentrations and coarse grain sizes (Bull and Kirkby 2002).

Condition Assessment with CRAM

Overall CRAM index scores for these sites ranged from 53 to 80 (μ= 68, σ= 6; Table 3; Appendix 4). AA 154 (C-44) received the highest overall index score and AA 356 (E-105), 269 (E-86), and 124 (B-35) were the three lowest scoring sites in the study area (Appendix 1). Based on the known precision for overall index scores, AA scores that differ by 11 CRAM points or greater should be considered to represent differences in overall condition (see Appendix 4). For example, AA 154 (C-44), with an Overall Index Score of 80, can be interpreted as having higher ecological condition than AA 103 (A-30), which received a score of 67. However, AA 53 (G-19) and AA 57 (G-21), which received overall index scores of 79 and 72, respectively, do not represent significant differences in overall condition. A similar interpretation can be made for Attribute scores. Two scores for the same Attribute that differ by less than 5 CRAM points should not be regarded as representing differences in condition. Table 2 lists the distribution of metric and submetric scores (A-D) for all sites combined.

Table 3. Summary statistics of CRAM scores from the study site.

CRAM Index and Attributes	Mean	SE	SD	Median	Maximum	Minimum
Overall Index Score	68	1	6	69	80	53
Landscape Context	95	1	9	100	100	48
Hydrology	91	1	5	92	100	67
Physical Structure	41	1	13	50	75	25
Biotic Structure	46	1	9	44	75	31

No dramatic spatial trends in drainage condition scores were evident on the study site (Appendix 6). Some assessments areas located near the perimeter of the study site tended to score lower than sites located near its center.

Buffer and Landscape Context Attribute

For riverine CRAM, this attribute is scored with two metrics 1) the continuity of the riparian corridor over a prescribed distance upstream and downstream of the assessment area 2) the amount, size, and condition of the buffer on both sides of the assessment area. Final condition scores for the Landscape and Buffer Context attribute ranged from 48-100 (μ= 95, σ= 9; Table 3). Overall, this was the highest scoring CRAM attribute, with 67% of sites assessed receiving a score of 100 (the highest obtainable for this attribute). The metrics comprising this attribute assess the ability of wildlife to enter the riparian area from outside of it at any place and to move easily through adequate cover along the riparian corridor through the assessment area from upstream and downstream.

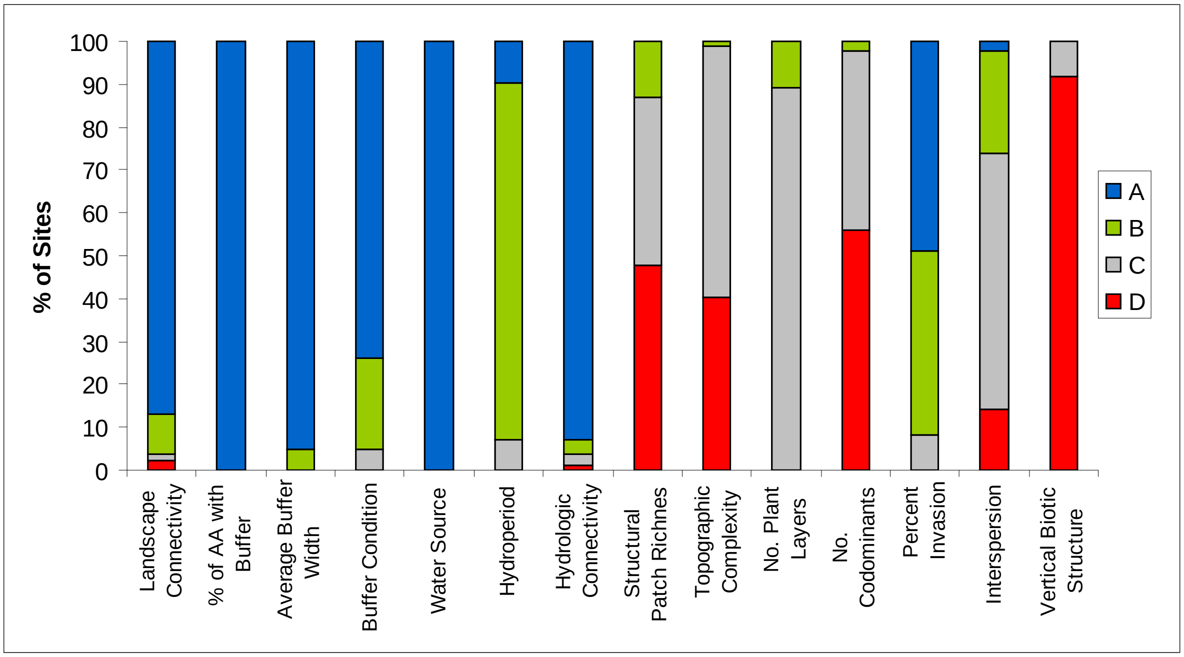
Landscape Connectivity Metric

The majority of sites (87%) scored an “A(12)” for this metric (Figure 3). CRAM AAs 269 and 356 were the only AAs within the study site to receive a “D(3)” score for the landscape connectivity metric. This was due to their proximity to Plaster City and its effect on the continuity of the landscape/riparian connectivity for both of these sites.

Buffer Metric

The majority of sites received very high scores for all of the submetrics that comprise the Buffer Metric. All sites (100%) had at least 5 meters of suitable buffer on each side of the AA and scored an “A(12)” for the Percent AA with Buffer Submetric. Most sites (95%) had a mean buffer width of 250 m and scored an “A(12)” for the Buffer Width Submetric (a site must have a mean buffer width of 190 meters to receive an “A’). For the Buffer Condition Submetric, 74% of sites received an “A(12)”, indicating that the buffer is dominated by native vegetation, has undisturbed soils, and subject to little or no human visitation (Figure 3).

Figure 3. Distribution of metric/submetric scores (A-D) based on the percent of sites (N=84).



Hydrology Attribute

For riverine CRAM, this attribute is scored with three metrics: 1) Water Source (direct fresh water sources to the channel during the dry season), 2) Channel Stability (the degree of channel aggradation or degradation), and 3) Hydrologic Connectivity (assessed based on the degree of channel entrenchment, calculated as the flood-prone width divided by the bankfull width; Leopold *et al*. 1964, Rosgen 1996, Montgomery and MacDonald 2002). These metrics are discussed in detail below. Final scores for the Hydrology attribute ranged from 67-100 (μ= 91, σ= 5; Table 3). Overall, this CRAM attribute scored relatively high, with 86% of sites assessed receiving a final score of 92 or greater. Metrics of the Hydrology attribute in CRAM assess the sources, quantities, and movements of water, plus the quantities, transport, and fates of water-borne materials, particularly sediment as bed load and suspended load (Collins et al. 2008).

Water Source Metric

This metric assesses the kinds of direct inputs of water into the AA during the dry season, as well as any diversions of water from the AA that affect the extent, duration, and frequency of saturated or ponded conditions within the AA. Because all drainages assessed with CRAM within the study site were characterized as ephemeral and contained no surface flow at the time of the assessment, all sites scored an “A (12)” for this metric (i.e. their freshwater sources are either precipitation or they naturally lack water in the dry season; Figure 3). There was no indication that unnatural (anthropogenic) sources of water contributed to any dry season flows.

Although all of the drainages did not contain surface flow at the time of the CRAM assessments, it is possible that they could contain flowing water in the dry season (albeit infrequently) following precipitation events large enough to produce runoff. Rainfall is extremely scant in the Yuha Desert, and long periods of time may occur between runoff events. Although the majority of the rainfall occurs during winter, the majority (65%) of annual runoff occurs during the summer months of July to September. Runoff events, when they occur, are generally activated by intense summer monsoon rains that produce short duration flash flooding with high flow peaks. Although winter storms produce more rain on average than summer monsoons, they are widespread and low-intensity, and expected to contribute less to runoff events on the project site, especially due to the relatively small size of the site's contributing watershed. For larger watersheds, winter runoff can potentially have a more pronounced effect on surface flow in arid, ephemeral systems.

Channel Stability Metric

This metric assesses the degree of channel aggradation (i.e. net accumulation of sediment on the channel bed causing it to rise over time) or degradation (i.e. net loss of sediment from the bed causing it to be lower over time). Associated indicators are related to the frequency and duration of flooding (as indicated by the local relationship between stream depth and time spent at depth over a prescribed period), and flood frequency (i.e. how often a flood of a certain height is likely to occur). These characteristics, plus channel form in cross-section and plan view, steepness of the channel bed, material composition of the bed, sediment loads, and the amount of woody material entering the channel all interact to create the physical structure and form of the channel at any given time. The majority of AAs (83%; Figure 3) on the study site scored a "B(9)" for the Channel Stability metric. Some indicators of aggradation were observed at most sites, none of which were considered severe.

The majority of sites assessed with CRAM in the study area were characterized by various indicators of equilibrium and aggradation. Indicators of active degradation were very rarely encountered. The three most common indicators of equilibrium observed included 1) channels (both low flow and secondary channels) with a well-defined bankfull contour), 2) little evidence of active undercutting or burial of riparian vegetation, and 3) well-sorted of bed material on channel bars. The three most common indicators of aggradation observed included 1) an active floodplain with fresh splays of course sediment, 2) perennial terrestrial/riparian vegetation encroachment into the channel, and 3) a planar bed.

Erosion, transport, and deposition of sediment all have the potential to occur on the study site. Transport of sediment into the site comes from south of Interstate 8, where several large basins drain through the site. When flooding occurs, detached sediment from these off-site basins can be deposited within the site. Sediment from off-site basins entering the project area south of the site is transported through existing washes on-site, and typically exists through the northern and northeastern sections of the site. However, due to the presence of the railroad and Dunaway Road embankments on the north/northeast, not all the sediment is able to exit the site, creating a net positive sediment balance in the channels on the site over time.

Hydrologic Connectivity Metric

This metric is scored by assessing the degree to which the lateral movement of flood waters or the associated upland transition zone of the AA and is restricted by unnatural features such as levees, sea walls, or road grades. For fluvial systems, Hydrologic Connectivity is assessed based on the degree of channel entrenchment, or the inability of flows in a channel to exceed the channel banks. Where an entrenchment ratio was measured, (93% Figure 3) scored an "A(12)" for this metric, indicating that channels are not entrenched (mean entrenchment ratio for sites was 6.6 m).

Physical Structure Attribute

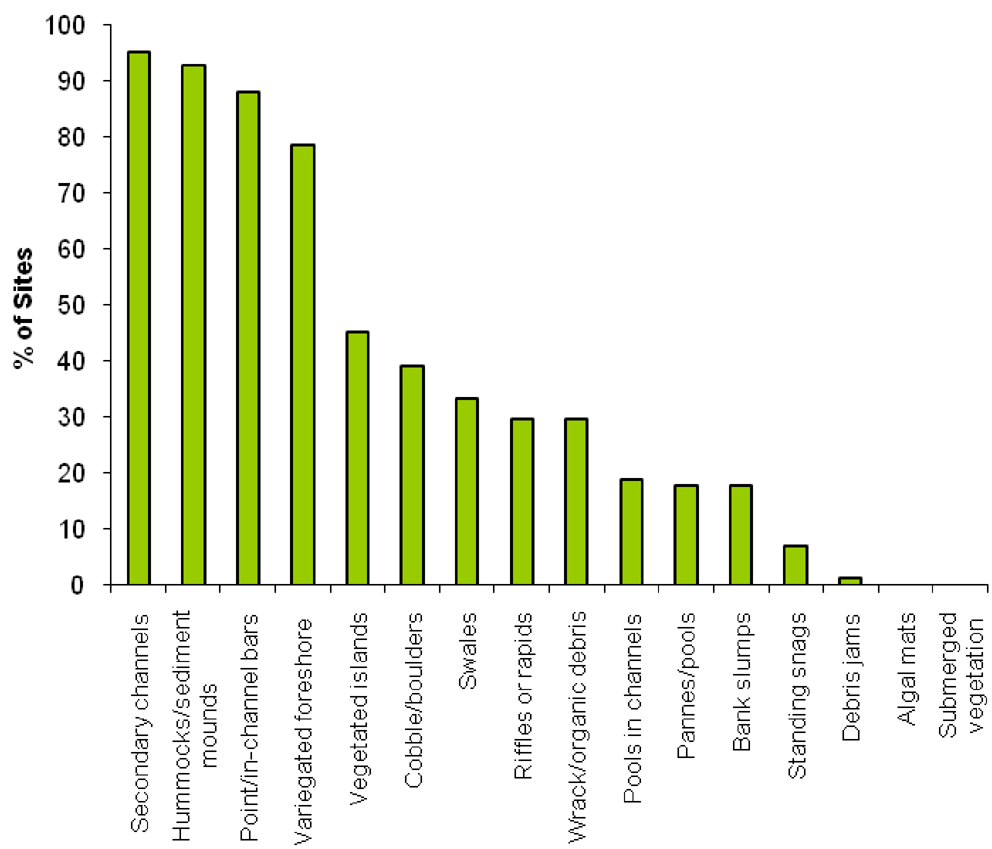
For CRAM, this attribute is scored with two metrics: 1) Patch Richness (the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species) and 2) Topographic Complexity (the spatial arrangement and interspersion of patch types). The topographic complexity metric assesses the variety of elevations within a wetland due to physical, abiotic features and elevations gradients. Typical indicators of macro- and micro-topographic complexity for riverine systems include pools, runs, glides, pits, ponds, hummocks, bars, debris jams, cobble, boulders, slump blocks, tree-fall holes, plant hummocks. Final scores for the Physical Structure attribute ranged from 25-75 (μ= 41, σ= 13; Table 3). Overall, this was the lowest scoring CRAM attribute, with 30% of sites assessed receiving a final score of 25 (the lowest possible for this metric).

Metrics of the Physical Structure attribute in CRAM focus on physical conditions that are indicative of the capacity of an area to support characteristic flora and fauna. The distribution and abundance of organisms in riverine systems are largely controlled by physical processes and the resulting physical characteristics of habitats (Frissell *et al.* 1986). The richness of physical, structural surfaces and features in a wetland reflects the diversity of physical processes, such as energy dissipation, water storage, and groundwater exchange, which strongly affect the potential ecological complexity of the wetland. The basic assumption is that natural physical complexity promotes natural ecological complexity, which in turn generally increases ecological functions, beneficial uses, and the overall condition of a wetland. For each wetland type, there are visible patches of physical structure that typically occur at multiple points along the hydrologic/moisture gradient.

Structural Patch Type Richness Metric

A mean number of six (6) patch types were recorded at all sites, and almost half of the sites assessed (48%; Figure 3) received a score of "D(3) for this metric (i.e. five or fewer patch types were observed).All sites assessed were non-confined riverine systems, and although 16 patch types expected were expected to occur, only 14 were observed (Figure 4).

Figure 4: Occurrence of patch types based on the percent of sites assessed in the study area.



Topographic Complexity Metric

Most sites (58%) scored a "C (6)" or "D (3)" (40%; Figure 3) for this metric. Most AAs were characterized by a single bench or obvious break in slope. Only one site (154) scored a "B (9)" for this metric and no sites scored an "A (12)". This metric is scored using a diagrammatic sketch and corresponding narrative.

Biotic Structure

Metrics comprising this attribute focus on aspects of the vascular vegetation that contribute to a wetland's material structure and architecture. It is scored with three metrics 1) Plant Community (number of vegetation layers, dominant plant species richness, and the number of invasive co-dominant species), 2) Horizontal Interspersion and Zonation (the number of distinct plant zones and the amount of edge between them), and 3) Vertical Biotic Structure (the degree of overlap among plant layers). Final condition scores for the Biotic Structure attribute ranged from 53-80 (μ= 46, σ= 9; Table 3). Overall, this was the second lowest scoring CRAM attribute, with 73% of sites assessed receiving a final score of 47 or less.

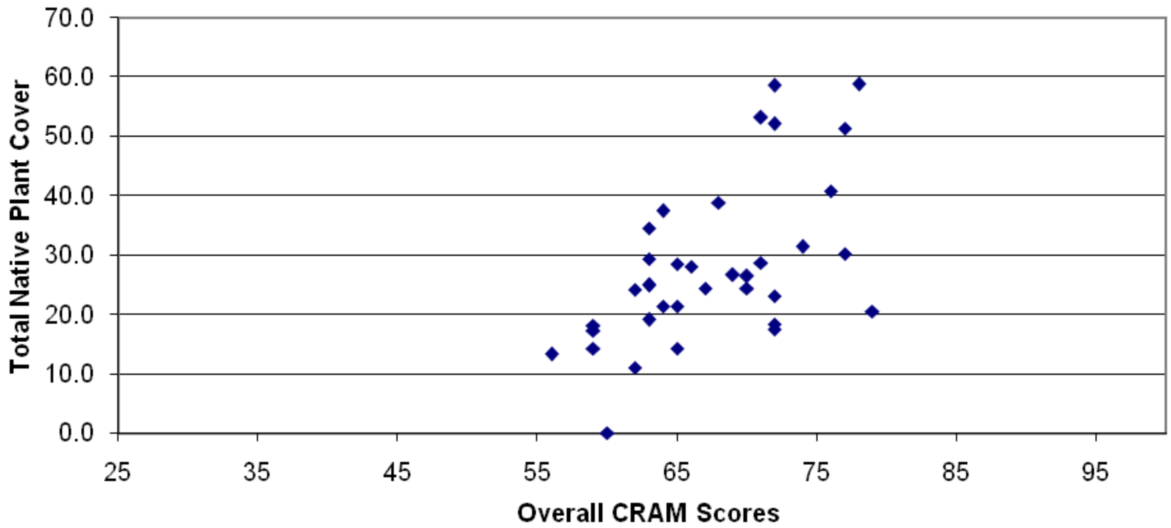
Plant Community Metric

The Plant Community Metric is scored as the average of three submetrics (number of vegetation layers, dominant plant species richness, and the number of invasive co-dominant species). To be counted in CRAM, a plant layer must cover at least 5% of the portion of the AA that is suitable for that layer. The Co-dominant Species submetric is assessed as living vegetation that comprises at least 10% relative cover within each plant layer identified in the AA. The number of invasive co-dominant species for all plant layers combined is assessed as a percentage of the total number of co-dominants, based on the results of the Number of Co-dominant Species submetric.

Within the study area, 89% received a "C(6)" for the Plant Layer submetric (a mean of two plant layers, although up to three layers were recorded at a few sites), 56% of sites scored a "D(3)" for the Number of Co-dominant Species submetric (a mean of five species), and 49% and 43% of sites scored an "A(12)" and "B(9)", respectively, for the Percent Co-dominant Species that are Invasive submetric (Figure 3). The six most common co-dominant species to occur in the washes are (in order): *Ambrosia dumosa* (bursage), *Larrea tridentate* (creosote), *Pleuraphis rigida* (big galleta), *Aristida adscensionis* (sixweeks threeawn), *Brassica tourneforti* (Sahara mustard), and *Encelia frutescens* (button brittlebush). Of these only *Brassica tourneforti* is non-native and considered invasive.

CRAM Index Scores were significantly correlated (r =0.58; p=.0001) with the total cover of native plant species calculated from the point-intercept transects conducted at the CRAM assessment sites (Figure 5). A similar relationship was observed for overall CRAM scores and plant species richness. There was a mean total native plant cover of 22.2% for all sites. Non-native cover was less than 1%. A total of 31 plant species (4 of which were invasive) were recorded from the point-intercept transects. Average heights for each plant species intercepted ranged from 0.01 cm-1.12 m.

Figure 5. Correlation of Overall CRAM Scores with total native plant cover at CRAM Assessment areas.



Horizontal interspersion and Zonation

Horizontal biotic structure refers to the variety and interspersion of plant "zones." Plant zones are plant monocultures or an obvious multi-species association that are arrayed along gradients of elevation, moisture, or other environmental factors that seem to affect the plant community organization in plan view. Interspersion is essentially a measure of the number of distinct plant zones and the amount of edge between them. The existence of multiple horizontal plant zones indicates a well-developed plant community and predictable sedimentary and bio-chemical processes. The amount of interspersion among these plant zones is indicative of the spatial heterogeneity of these processes. Richer native communities of plants and animals tend to be associated with greater zonation and more interspersion of the plant zones

60% of sites on the project site received a "C(6)" for this metric, indicating a low degree of horizontal interspersion/zonation (Figure 3).

Vertical Biotic Structure

The vertical component of biotic structure is commonly recognized as the overall number of plant layers, their spatial extent, and their vertical overlap relative to the expected conditions. The same plant layers used to assess the Plant Community Composition metrics are used to assess Vertical Biotic Structure. The overall ecological diversity of a wetland tends to correlate with the vertical complexity of the wetland's vegetation. For many types of wetlands in California, overlapping layers of vegetation above or below the water surface contribute to vertical gradients in light and temperature that result in greater species diversity of macroinvertebrates, fishes, amphibians, and birds. In riparian areas, the species richness of birds and small mammals tends to increase with the density and number of well-developed, overlapping plant layers. Many species of birds that nest near the ground or water surface in wetlands commonly require a cover of vegetation at their nest sites. Multiple layers of vegetation also enhance hydrological functions, including rainfall interception, reduced evaporation from soils, and enhanced filtration of floodwaters.

92% of sites (Figure 3) on the study site received a “D(3)” score for this metric, indicating one of three conditions 1) less than 25% of the vegetated AA supports moderate overlap of plant layers, 2) two layers are well represented with little overlap, or 3) AA is sparsely vegetated overall.

Stressors

Very few anthropogenic stressors affecting CRAM assessment areas were recorded on the study site. The few stressors that were recorded were observed at the landscape scale (within 500 m of the AA) and included transportation corridors (for perimeter sites) and active recreation in the form of evidence of off-road vehicle activity.

DISCUSSION

This research represents the first phase of the development a method to assess the ecological conditions of arid, ephemeral/intermittent streams. The goal of this initial effort was to evaluate the performance of CRAM for arid land ephemeral systems and establish any relationships with the ancillary data that were collected as part of this project. This information will help to inform an initial recommendation for refinement or modification of specific CRAM metrics as they relate to arid emphemeral stream systems. The results in this technical report should be applied only in the context of the study area and should <u>not</u> be considered to address larger issued as they pertain to the assessment of arid, ephemeral stream courses throughout California. Any generalizations as they apply to these systems would need to involve a larger study area, a broader technical advisory team, and a vetting process that involves a thorough technical and stakeholder review of findings and recommendations.

Performance of CRAM in Arid, Ephemeral Stream Systems

The results of this baseline study indicate that the theoretical construct of CRAM can be applied to arid, ephemeral streams. The current Riverine Module was able to discriminate along a gradient of drainage conditions within the study site. Some AAs received higher overall index and attribute scores than others that were outside of the margin of error for the method (see Appendix 2 for site scores). Therefore, it is statistically valid to describe some sites as having a better condition than others based on CRAM condition scores. However, the study site is located in relatively undeveloped, remote area, and few anthropogenic stressors were recorded for the CRAM assessments, so it could be expected that sites would have higher condition scores that reflected by the probabilistic survey (e.g. only one site had an overall score of 80). This indicates that certain metrics in the current Riverine Module will need to be recalibrated arid, ephemeral streams.

Delineation of the CRAM Assessment Area (AA)

Delineation of a CRAM AA using the current CRAM guidelines was tractable for the majority of sites assessed in the study area. Past studies have shown that the terrace floodplain in arid west intermittent and ephemeral streams maintains its vegetative and morphology composition with discharges as large as an 18.7-year flood event (Lichvar et al. 2009). Bankfull and active channels basically function as one channel and the outer boundary of this single channel represents the extent off ordinary high water. This outer boundary generally corresponded to the lateral extent of most of the areas assessed in the study area.

However, determining the lateral extent of the wider, shallow wash areas in downstream reaches of the study area was problematic for several sites. In addition to their pronounced widths, the lower reaches of ephemeral streams were noted for their planar, flat bed topography and discriminating lateral extent using the current guidance was generally not applicable. For these sites, reliance on the practitioner’s best professional judgment was used to delineate this boundary, defined as the point where fluvial features could not longer be easily discerned in the field. This rule set led to the establishment of a few relatively wide assessment areas.

Landscape and Buffer Context

Because this attribute of CRAM addresses general landscape aspects of the riparian vegetation and buffer of a site, the metrics as scored with the Riverine Module are generally applicable to sites within the study area. The metric scores for this attribute reflect that the study site is located in a relatively remote section of the Yuha Desert and few interruptions to the riparian continuity and impacts to the buffer were present for most of the areas assessed. Although the existing riparian vegetation on the study site may differ in complexity, structure and species composition from more mesic riparian systems, the connectivity of the riparian corridor and buffer of arid, ephemeral streams still provide important structural habitat for a variety of wildlife species, play an important role in the dispersal of both animals and plants, and also shade and stabilize fluvial environments, providing habitat for aquatic organisms (Naiman et al. 1993, Patten 1998).

Generally as the hydrologic regime shifts from perennial to ephemeral, the riparian vegetation composition shifts towards more drought-tolerant (xeroriparian) species, vegetation cover declines, riparian woodlands give way to riparian shrublands, and canopy height and upper canopy vegetation volume decline (Leenhouts et al. 2006; Stromberg et al. 2007). Along small desert washes, vegetation composition and structure overlap considerably with those of the surrounding desert uplands (Bloss and Brotherson 1979; Warren and Anderson 1985) and consist primarily of small, xerophytic shrubs and trees that can occur in both riparian and adjacent upland habitats. This type of habitat typified the riparian vegetation of most of the CRAM assessments areas in the study area.

Hydrology

All metrics comprising the Hydrology Attribute all received relatively high scores for desert washes on the study site (see Figure 3). Most of the sites assessed consistently exhibited some indicators of equilibrium and aggradation (as described on the CRAM worksheet for assessing riverine channel stability). However, some explanation is needed on interpretation and application of some of these metrics for arid land stream systems in general.

Channel Stability

Ephemeral streams are unique in that they lack permanent flow except in response to rainfall events. Nevertheless, they perform the same critical hydrologic functions as perennial streams: they move water, sediment, nutrients, and debris through the stream network and provide connectivity within the watershed. These streams experience extreme and rapid variations in flood regime, and as a consequence rarely reach process-form equilibrium where flow conditions change too rapidly for bedforms to develop a form matching that flow, so sedimentary structures can give a misleading picture of the flow that occurred (North 2005).

The Channel Stability Metric of CRAM is based on the concept of stream equilibrium. Due to the wide discrepancy in record and average annual peak flows in arid regions and the high sensitivity of arid-region rivers to change, dryland rivers rarely reach this state (Graf 1988a, Tooth and Nanson 2000a) and the general applicability of the equilibrium concept to desert regions has been called into question (Tooth 2000). The effects of extreme events persist in deserts for long periods because of the inability of the stream channel to recover or “heal” from large floods, in part due to the absence of sufficient revegetation (Baker 1977, Graf 1988a).

Therefore, it is important to note that indicators of aggradation should be expected for naturally functioning arid, ephemeral streams. Perturbation to the natural process of sediment delivery and flood waters could this lead to incision/downcutting of the stream channel. In this case, these indicators would be indicative of a lower condition rating for CRAM. This was not observed for systems within the study areas as all sites were subject to relatively natural processes of water and sediment delivery throughout most of their reach.

Hydrologic Connectivity

Although most sites assessed in the study area scored high for this metric (i.e. channels were generally not entrenched), the conceptual model and field techniques used to assess this metric in the field under the current CRAM Riverine Module will require reevaluation for aridland streams. Studies suggest that ephemeral (and intermittent) streams in the Arid West do not have separate bankfull channels and active floodplains; instead the bankfull and active floodplain combine to make one active floodplain where the majority of fluvial activity occurs (Lichvar and McColley 2008). The low-flow channel in the active floodplain of ephemeral streams differs from the bankfull channel of perennial streams. In the Arid West, the low-flow channel will form and relocate during low to moderate discharge events (5–10 years) instead of being maintained by continuous flows, as in perennial streams.

Further, the delivery of water to a channel is dependent largely on the timing, duration, and amount of water that falls on the surface and subsequently runs off, which is dependent on soil type, and condition of the contributing watershed and buffer. Small tributaries generally have land-dominated hydrographs as opposed to stream-flow dominated, because they mainly drain adjacent land surfaces (Levick et al. 2008). Therefore, the importance of hydrologic connectivity for streams in arid environments relates more to the delivery of water, sediment, nutrients, compounds, etc. to downstream areas, rather than lateral connectivity between the channel and its uplands (i.e. condition of the upstream basin/contributing watershed is a driving factor for streams arid land stream systems. A revision of this metric that considers the connectivity between multiple channels in the floodplain as well as the upstream condition of the contributing watershed may be a more appropriate measure for aridland streams. This could include the development of a metric that assesses the connectivity between the main low flow channel and its numerous secondary channels within the greater floodplain.

Physical Structure

The metrics used to score the Physical Structure Attribute of CRAM (physical patch types and topographic complexity) generally scored very low for the ephemeral washes assessed on the study site (see Figure 3).

In ephemeral stream channels, numerous patch types are possible. The vegetation that establishes on sand bars typically initiates the formation of various depositional features such as small current shadows, bars, benches, ridges, or islands (Tooth and Nanson, 2000). Spatially extensive assemblages of any plant species have the potential to alter geomorphology and geomorphic processes through bioturbation, alteration of nutrient or fire cycles, and patterns of succession (Lovich, 1996).

In the lower reaches of ephemeral streams, physical patch types, when encountered, are typically less common or of a different type when compared to higher reaches. Channel bars are often flat-topped and rise only 10-20 cm above the thalweg (Leopold et al. 1966; Frostick and Reid 1977, 1979). Wide, shallow flows in lower stream reaches suppress the secondary current cells that encourage the development of bars (Reid and Frostick, 1997). Rapidly receding flows can further destroy or modify bedforms such as ripples, dunes, and antidunes that may develop at greater flow depths. Bedforms in streams are created when water currents carry loose grains across the horizontal surface of unconsolidated sediments, the size and shape, which are determined by the flow velocity, direction, and consistency.

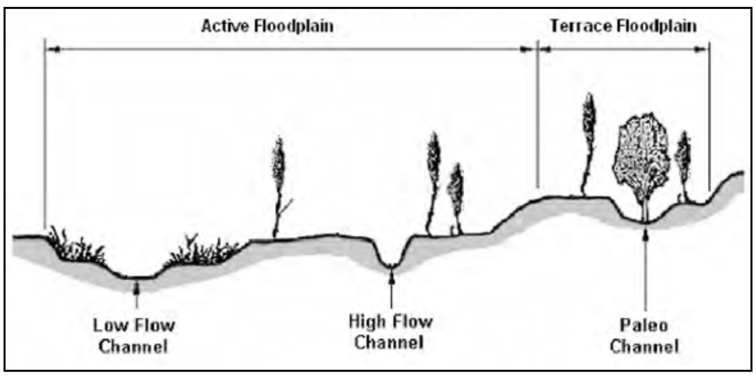
The rating for CRAM patch types is based on the percent of total expected patch types for a given type of aquatic system. Generally, most sites cored low for this metric, with few patch types observed. However, this may be misleading for several reasons. Many of the patch types assessed with the current module would not be expected to occur in for arid, ephemeral streams (e.g. algae, submerged vegetation), thus leading to artificially deflated scores. Furthermore, some patch types that could be expected to occur (e.g. silt deposits, mud cracks, and animal burrows; Appendix 7a-b) are not considered for riverine systems in the current module. Animal burrows (mammal and insect) were especially prevalent at several of the sites assessed. Therefore, the total expected patch types for arid, ephemeral streams should be revised by adding/deleting types, as appropriate, for more accurate scoring of this metric.

Topographic Complexity

For CRAM, topographic complexity is evaluated by observing the number of elevational features that affect moisture gradients or that influence the path of water flow along a transect across the assessment area (as viewed along a typical cross-section), and the amount of micro-topographic relief along the gradients or flow paths. Topographic gradients may further be indicated by plant assemblages with different inundation and/or saturation tolerances. Because almost all sites scored relatively low for this metric, the way in which it is assessed for arid, ephemeral streams will require revision.

To receive a high for this CRAM metric, the presence of two elevational changes (i.e. "benches" or breaks in channel slope) is required. In perennial streams, benching is facilitated by variations in flow and sediment regimes. Because aridland streams experience extreme and rapid variations in flood regime, the formation of benches is not a process that is expected to occur. Revised cross-section diagrams for arid stream systems would assist in interpretation of the topographic complexity metric, and potentially generate more variable scores for this metric. For example, these cross-section diagrams could depict representations of in-channel features (low flow channel, active floodplain, and adjacent terraces e.g. Figure 6) rather than elevational changes associated exclusively with the edge of the assessment area.

Figure 6. Typical arid, ephemeral/intermittent stream cross section and its associated hydrogeomorphic floodplain units (Lichvar et al. 2009).



Biotic Structure

Plant Community Composition

The Plant Community Metric scored consistently low for all sites assessed in the study area. This was not surprising, as the Yuha Desert (the region in which the study area is located) is characterized by extremely low rainfall and sparse vegetation. It is expected that riparian plant diversity (i.e co-dominant species) would be low for this region.

The composition of riparian vegetation along desert streams reflects the vegetation composition of its watershed and floristic province, as well as with drainage size, climatic regime, latitude, longitude, elevation, aspect, and soil characteristics. As the hydrologic regime shifts from perennial to ephemeral, vegetation composition shifts towards more drought-tolerant species, vegetation cover declines, riparian woodlands give way to riparian shrublands, and canopy height and upper canopy vegetation volume decline (Leenhouts et al. 2006; Stromberg et al. 2007). Along small desert washes, vegetation composition and structure overlap considerably with those of the surrounding desert uplands (Bloss and Brotherson 1979; Warren and Anderson 1985) and consist primarily of small, xerophytic shrubs and trees.

The CRAM assessment “window” (the period of time each year when CRAM assessments should be conducted) is another factor that must be considered for assessing the Plant Community Metric for ephemeral systems in arid regions. During seasonal dry periods, plant species diversity along ephemeral stream channels can even be lower than that of the adjacent uplands (Leitner 1987). However, during seasonal wet periods, stem and leaf succulents, perennial grasses, annual grasses and forbs can become seasonally abundant and species diversity levels along some ephemeral stream reaches can equal that of perennial streams (Stromberg et al 2009). In order to account for the seasonally abundant herb (typically short) layer associated with arid, ephemeral stream systems, an earlier and abbreviated assessment window may be necessary so that co-dominant plant species richness can be acutely assessed.

In general, the CRAM Assessment Window falls within the growing season for the characteristic plant community of the system to be assessed (Collins et al. 2008). For example, the growing season for seasonal wetlands (e.g., vernal pools, playas, and some seeps) will generally be March through June, although it can be much shorter depending on local environmental factors. Because the timing of the growing season varies with altitude and latitude, the CRAM assessment window might vary within and between regions, and local or regional cues may be needed to determine when the window opens and closes each year. The best cues will be the early evidence of new growth of plants, and the subsequent senescence of the plants, for any given wetland types. For example, the assessment of ephemeral streams in arid regions might begin early in the growing season (the window is opening) but before the end of springtime and desiccation of the soils (the window is closing). For the region in which the study area is located (Yuha Desert), the CRAM assessment window may needed to be very short (e.g. January-April) to account for the extremes in temperature and very low rainfall.

Horizontal Interspersion and Zonation

Riparian vegetation in semi-arid and arid regions is typically spatially heterogeneous. Often, distinct vegetation patch types can be readily distinguished on the basis of species composition, species dominance, and/or vegetation structure. Where hydrologic conditions do not support the growth of riparian forests, riparian zones in arid systems may still support vegetation communities distinct in composition or structure from nearby uplands (Stromberg et al. 1993, Evans 2001).

Vegetation structure also shifts as watershed size and flood intensity increase. On large, dry ephemeral streams with intense flood scour, species composition shifts towards pioneer species. Zonation can occur between fluvial surfaces within an ephemeral-stream bottomland, with the pioneer species sometimes being more abundant in the active channel bed than on the stream banks or flood plain (Bloss and Brotherson 1979). However, for other ephemeral streams, the floodplain contributes more to the plant community composition than the channel.

Given the low plant community composition of the study area, it is expected that plant horizontal interspersion and zonation would be correspondingly low. Although most sites scored a “C” for this metric, there was some variability in scores among the sites assessed that was not observed in the other metrics comprising the Biotic Structure Attribute (see Figure 3). For example, *Pleuraphis rigida* was one species on in the study area that was typically interspersed within the dry washes and seldom observed growing outside of the channels and floodplains. It could be expected that sites located in more mesic and botanically diverse desert regions could score higher for the horizontal interspersion and zonation metric. Therefore, based on the results of the probabilistic survey, this metric as assessed by the CRAM Riverine Module appears to conceptually apply to drainages within the study area, and could potentially have application to aridland stream systems in other regions.

Vertical Biotic Structure

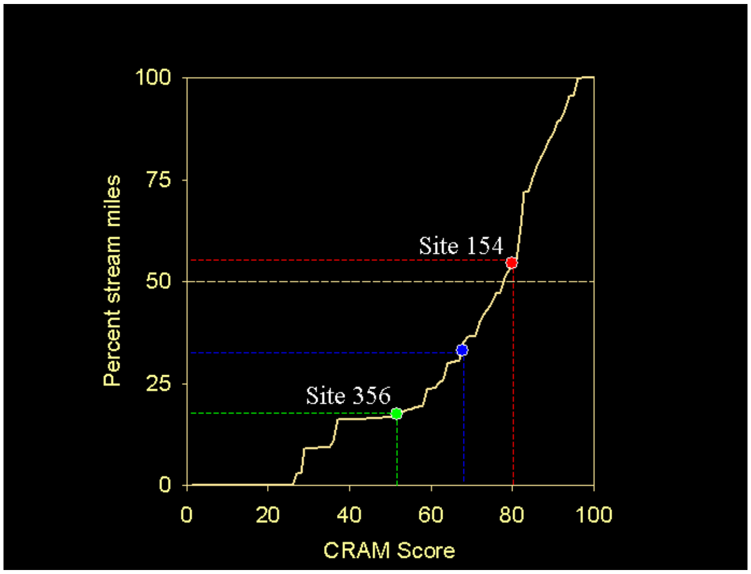
Like perennial stream systems, the vegetative communities along ephemeral and intermittent streams provide structural elements of food, cover, nesting and breeding habitat, and movement/migration corridors for wildlife that are not as available in the adjacent uplands. In ephemeral and intermittent streams, the structure and composition of the vegetation is related to the size of the stream and patterns of flow, although most of the diversity is comprised of herbaceous species (Bagstad et al. 2005). Functional services of these communities include moderating soil and air temperatures, stabilizing channel banks and interfluves, seed banking and trapping of silt and fine sediment favorable to the establishment of diverse floral and faunal species, and dissipating stream energy which aids in flood control (Howe et al. 2008).

Because almost all sites score a "D" for this metric (little to no vertical overlap of plant layers was observed), the Vertical Biotic Structure metric may have limited applicability for arid, ephemeral streams. The metric has potential for being removed from the Biotic Structure Attribute. For example, this metric was eliminated from the CRAM Module for Vernal Pools because most vernal pools are characterized by very low growing vegetation and vertical overlap is not expected in these systems. However, desert riparian systems can be more structurally complex that those of the study area and higher scores for this metric could be expected. Therefore, additional CRAM assessments of arid, ephemeral washes from other regions are necessary before any modifications are warranted.

Integrating the Results of Multiple CRAM Assessments

The assessment of a large study area with multiple CRAM assessments requires some type of an integrated summary of the results. One way to interpret CRAM scores collected from the study site is to compare these to the regional distribution of comparable scores from an ambient survey of riverine wetlands. At this time, the only comparable data available are from the Stormwater Monitoring Coalition's (SMC) survey of wadeable, perennial streams in coastal southern California. In this example, the mean, maximum, and minimum CRAM scores from the project site are compared to the distribution of CRAM scores collected from SMC sites (Figure 7). Site 154 (the highest scoring site in the study area) is still above the 50th percentile for wadeable, perennial streams in the State. Because this approach to summarizing multiple CRAM assessments does not involve any averaging of scores, it avoids the attending difficulties in data interpretation. This approach has the added benefit of linking a site assessment to ambient conditions in a way that clearly illustrates the interdependence of the datasets.
Ideally, CRAM scores from the study area should be compared with an ambient survey of other ephemeral drainages (which does not yet exist), thus this graph should be interpreted with caution. It is provided for illustrative purposes only as a way to present and interpret an integrated summary of CRAM scores in the context of an ambient assessment.

Figure 7. Mean (blue), maximum (Site 154; red), and minimum (Site 356; green) CRAM scores collected from the study site as viewed in context of a CRAM ambient survey of wadeable perennial streams in California.



CONCLUSION AND NEXT STEPS

This technical report represents the first iteration of a workplan to develop assessment tools for ephemeral and or intermittent streams in arid regions of California. In summary, the results of this baseline study indicate that the theoretical construct of CRAM can be applied to arid, ephemeral streams, but certain metrics in the current Riverine Module will need to be recalibrated for these systems. The Landscape and Buffer Attribute can potentially apply to arid systems as currently constructed. The Hydrology Attribute performs reasonably well for arid systems, but some of the current indicators and field techniques will need to be revised in order to assess specific metrics. The Physical and Biotic Structure attributes were the two most problematic attributes to apply to a condition assessment of drainages in the study area. The metrics associated with these attributes will need to be reevaluated in more detail for application to arid, ephemeral drainages. It is anticipated that future studies will continue to inform on the refinement, modification, and validation of CRAM for these systems.

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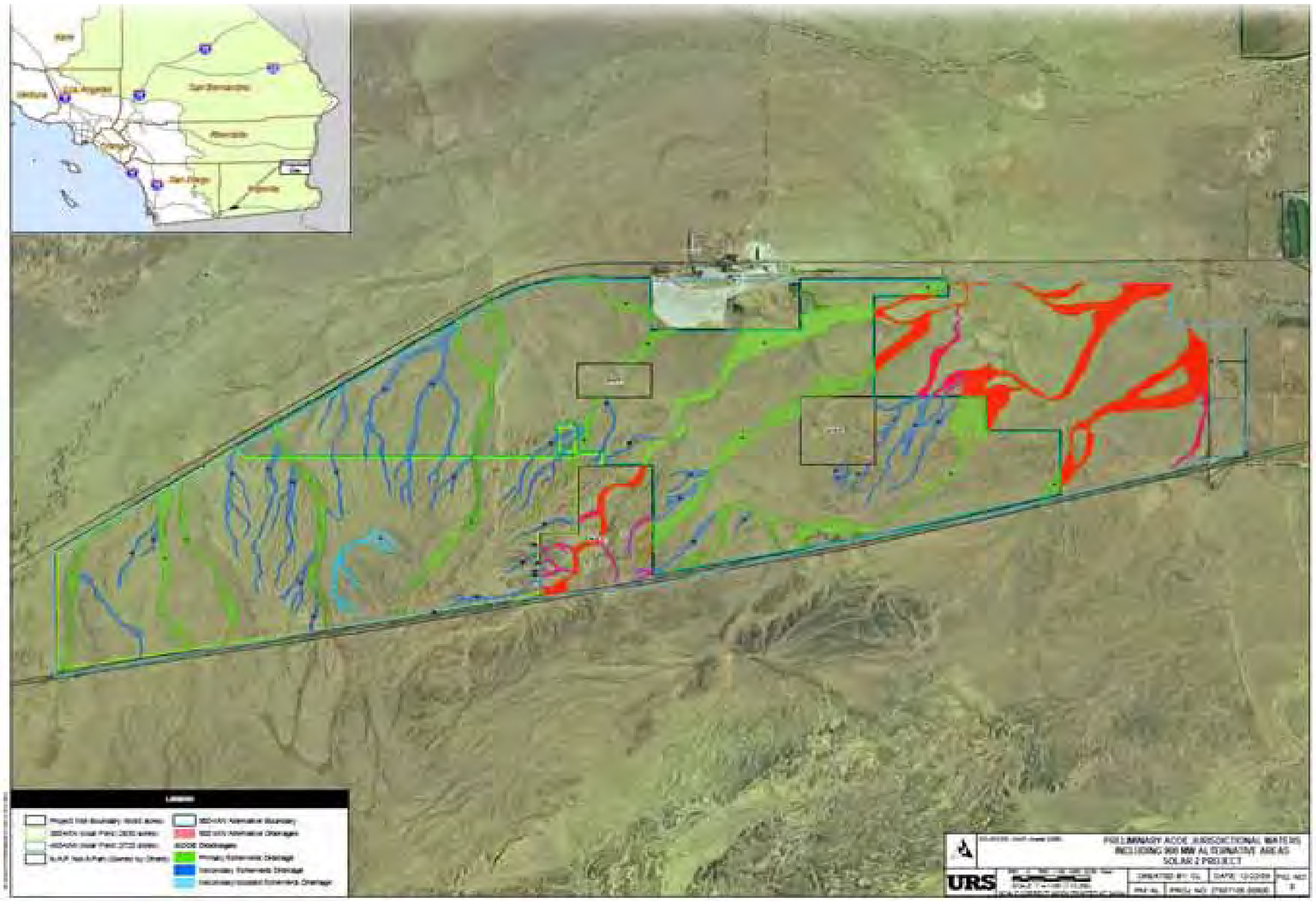
Appendix 1. Spatial distribution and relative extent of ephemeral drainages within the study area. Drainages in red were outside of the study area.



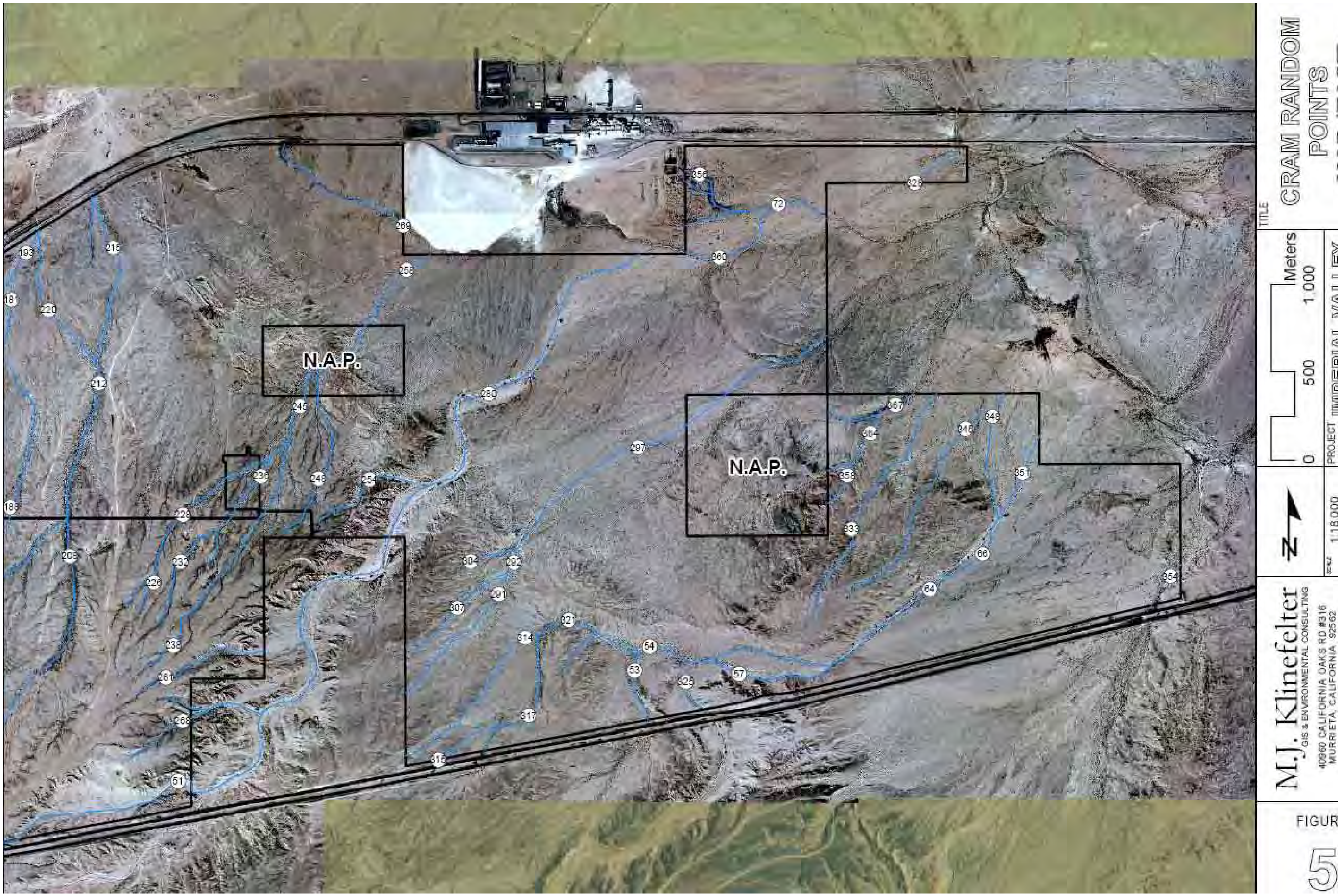
Appendix 2. Number, location and length of ephemeral drainages within the study area

Ephemeral Drainage ID*		Township/Range/Section		Upstream Limit		Downstream Limit		Linear Distance (feet)	Acres	Cowardin Class
Primary	Secondary	Upstream Limit	Downstream Limit	Longitude	Lattitude	Longitude	Lattitude			
I		16S/10E/27	16S/10E/22	-115.939	32.747	-115.926	32.764	6,970	23.66	Streambed
J		16S/10E/27	16S/10E/22	-115.924	32.749	-115.931	32.757	4,210	10.69	Streambed
K		16S/10E/27	16S/10E/22	-115.919	32.75	-115.921	32.767	6,800	36.6	Streambed
	K1	16S/10E/22	16S/10E/22	-115.927	32.756	-115.922	32.763	3,000	4.92	Streambed
	K2	16S/10E/22	16S/10E/22	-115.924	32.76	-115.922	32.762	1,110	2.62	Streambed
A		16S/10E/26	16S/10E/22	-115.914	32.75	-115.919	32.768	7,225	24.88	Streambed
	B	16S/10E/23	16S/10E/14	-115.913	32.76	-115.913	32.772	7,750	9.86	Streambed
C		16S/10E/26	16S/10E/14	-115.902	32.752	-115.908	32.774	8,650	40.25	Streambed
	C1	16S/10E/23	16S/10E/14	-115.911	32.756	-115.908	32.772	6,220	12.24	Streambed
	C2	16S/10E/23	16S/10E/14	-115.903	32.765	-115.9	32.778	8,035	9.72	Streambed
	C3	16S/10E/23	16S/10E/14	-115.908	32.757	-115.906	32.769	6,870	13.26	Streambed
	C4	16S/10E/26	16S/10E/23	-115.907	32.754	-115.904	32.76	4,990	7.11	Streambed
	C5	16S/10E/26	16S/10E/26	-115.904	32.751	-115.903	32.755	1,250	1.97	Streambed
D		16S/10E/25	16S/10E/12	-115.893	32.753	-115.884	32.787	13,700	74.73	Streambed
	D1	16S/10E/24	16S/10E/12	-115.895	32.766	-115.887	32.784	9,950	26.53	Streambed
	D2	16S/10E/24	16S/10E/13	-115.893	32.765	-115.888	32.782	12,750	28.59	Streambed
	D3	16S/10E/24	16S/10E/13	-115.89	32.765	-115.886	32.77	3,150	5.86	Streambed
E		16S/11E/19	16S/11E/09	-115.881	32.762	-115.831	32.789	23,700	198.94	Streambed
	E1	16S/11E/19	16S/11E/18	-115.88	32.764	-115.87	32.777	11,200	22.32	Streambed
	E2	16S/11E/18	16S/11E/17	-115.87	32.77	-115.864	32.772	2,000	2.44	Streambed
	E3	16S/11E/19	16S/11E/19	-115.881	32.761	-115.873	32.763	2,600	2.73	Streambed
	E4	16S/11E/19	16S/11E/19	-115.882	32.758	-115.878	32.76	1,950	1.57	Streambed
	E5	16S/10E/25	16S/11E/19	-115.888	32.754	-115.878	32.757	5,260	7.6	Streambed
F		16S/11E/20	16S/11E/16	-115.865	32.762	-115.839	32.78	10,500	104.08	Streambed
	F1	16S/11E/21	16S/11E/16	-115.842	32.767	-115.834	32.776	7,800	12.4	Streambed
	F2	16S/11E/20	16S/11E/20	-115.863	32.767	-115.858	32.769	2,400	4.62	Streambed
	F3	16S/11E/20	16S/11E/20	-115.865	32.764	-115.86	32.767	3,140	6.65	Streambed
G		16S/11E/20	16S/11E/15	-115.862	32.758	-115.826	32.776	17,600	115.44	Streambed
	G1	16S/11E/21	16S/11E/16	-115.84	32.765	-115.832	32.776	8,040	18.03	Streambed
	G2	16S/11E/21	16S/11E/15	-115.837	32.766	-115.829	32.776	4,475	9	Streambed
	G3	16S/11E/20	16S/11E/20	-115.865	32.758	-115.853	32.764	4,020	9.68	Streambed
H		16S/11E/22	16S/11E/22	-115.819	32.765	-115.817	32.767	970	7.4	Streambed
	SI	16S/10E/25	16S/10E/24	-115.899	32.754	-115.895	32.761	6,670	21.68	Streambed
Total								**224,955**	**878.07**	

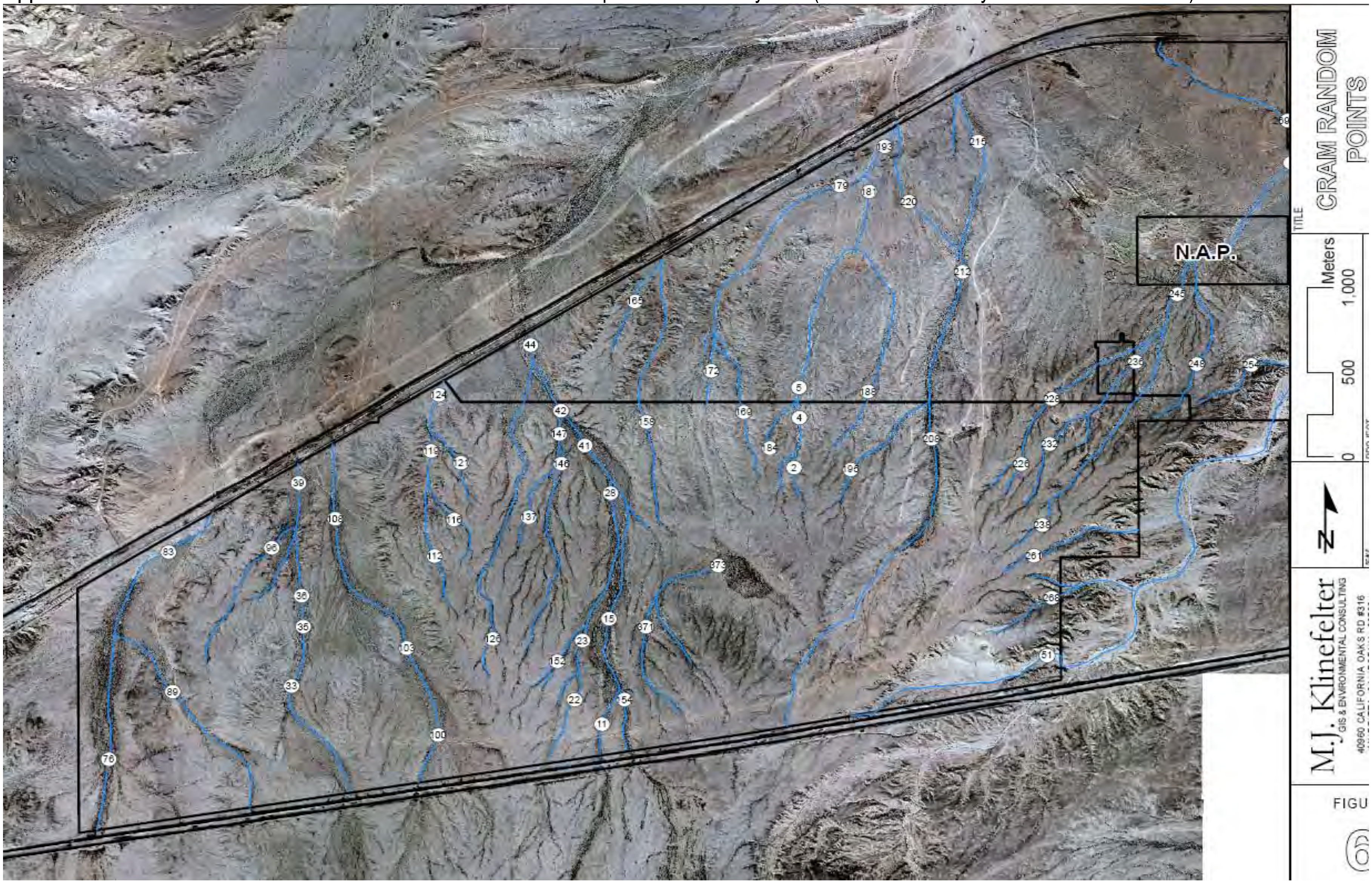
Appendix 3. List of sites assessed with CRAM. Note that the stream ID corresponds to the original jurisdictional delineation ID. Reach ID is the particular reach of stream that was assessed with CRAM.

Appendix 4. CRAM Overall, attribute, and metric scores by site.

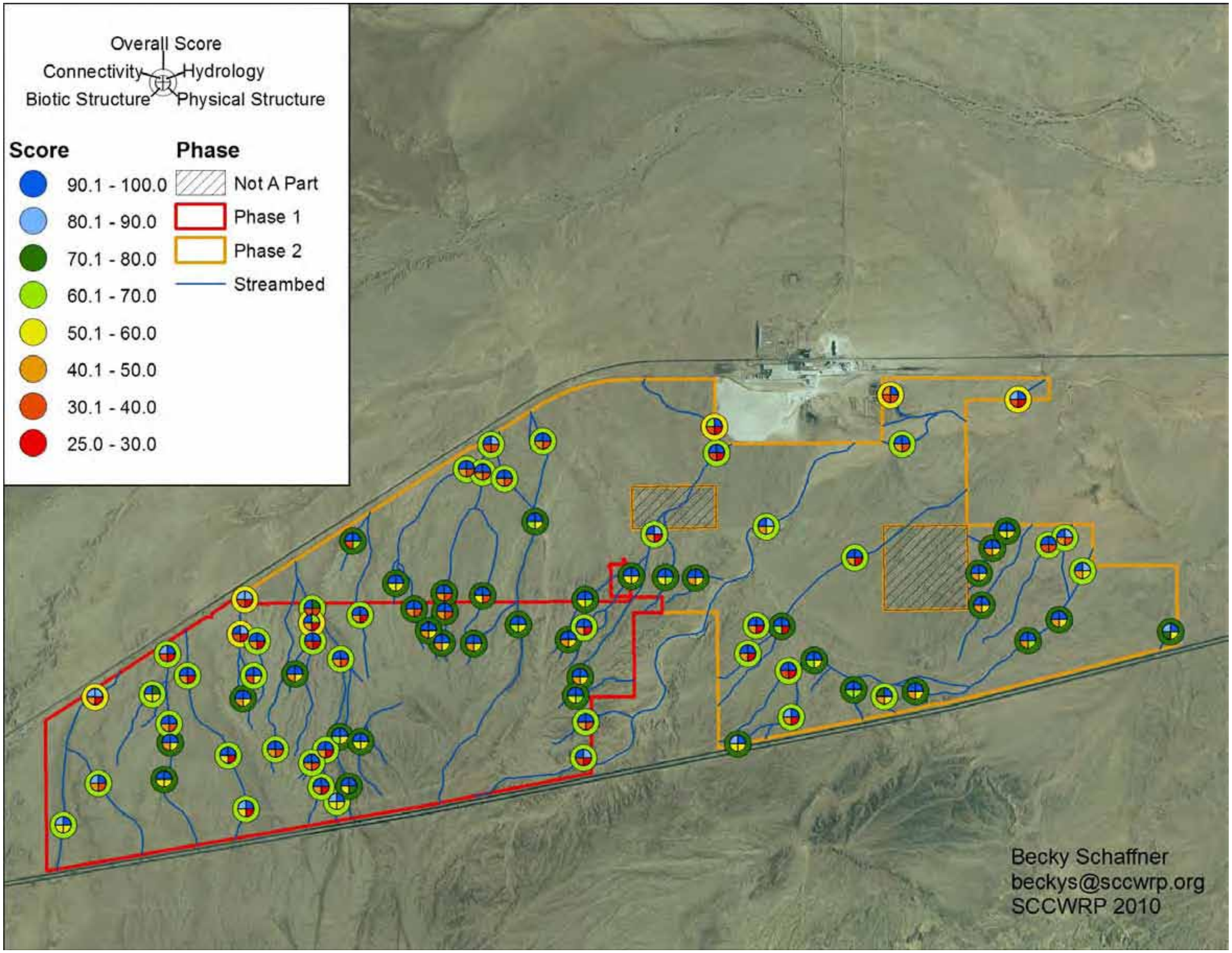
Appendix 5a. Location of CRAM assessment locations in the eastern portion of the study area (sites are denoted by numbered white circles).



Appendix 5b. Location of CRAM assessment locations in the western portion of the study area (sites are denoted by numbered white circles)



Appendix 6. Spatial distribution of overall CRAM Index and four Attribute scores collected at the study site from March 30-April 5, 2010.



Appendix 7a: Physical patch types observed within the study area a) silt deposits, b) bank slump, c) animal burrows, d) wrack/organic debris in channel

a.

b.

c.

d.

Appendix 7b: Physical patch types observed within the study area a) depression in channel, b) point bar, c) standing snag, d) plant hummock, e) cobble

a.

b.

c.

d.

e.

Attachment E – Additional Hydrology Reports that Evaluate the proposed LEDPA

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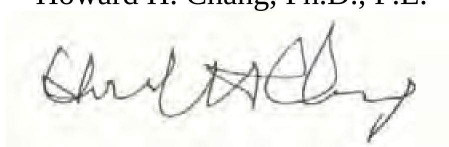
COMPUTATION OF LOCAL SCOUR ON STREAMBED INDUCED BY SUNCATCHERS

Submitted to
Ecosphere Environmental Services
Durango, CO

Prepared by
Howard H. Chang, Ph.D., P.E.



May 28, 2010

EXECUTIVE SUMMARY

SunCatchers will be installed in Washes A, D and F at the Solar Two project site in Imperil Valley, California. The pedestal supporting a SunCatcher induces local scour during the storm flow. Wash D is selected as the sample to determine the scour depths and stream bed surface areas affected by scour around the pedestals. A total of 465 SunCatchers will be installed in Wash D. The pedestals are 2 feet in diameter

The basic data on the hydraulics of flow were used to compute the depth of local scour as well as the area affected by scour using the equation recommended by the Federal Highway Administration given in Hydraulic Engineering Circular No. 18, FHWA, 2006. The computed results for Wash D are summarized below:

Maximum flow depth around pedestals = 1.27 feet
Maximum scour depth around pedestals = 2.97 feet
Range of scour depths around pedestals during peak 100-yr storm = 1.31 feet to 2.97 feet
Range of scour depths around pedestals at end of 100-yr storm= 0.66 feet to 1.49 feet

Maximum area affected by scour during peak 100-yr storm = 78.0 square feet
Range of area affected by scour during peak 100-yr storm = 20.5 to 78.0 square feet
Range of area affected by scour at end of 100-yr storm = 12.8 to 33.6 square feet

Average maximum scour area during peak 100-yr storm = 44.86 square feet
Average area affected by scour at end of 100-yr storm = 21.87 square feet

Number of pedestals in Wash D = 465
Total maximum scour area = 44.86 x 465 = 20,860 square feet
Total scour area at end of storm 21.87 x 465 = 10.167 square feet
Land surface area of Wash D covered by 100-yr storm = 3,090,000 square feet
= 70.93 acres

Ratio of maximum scour area to total wash area = 0.00675 = 0.675%
Ratio of scour area at end of storm to total wash area = 0.00329 = 0.329 %.

In summary, local scour will be induced by SunCatcher pedestals. The scour depth and area affected by scour have been determined based on the 100-yr storm. The scour depth and area affected by scour are the largest during the peak flow; they become partially refilled as the flow recedes. The total area affected by local scour around SunCatcher pedestals is less than one percent of the wash area.

I. INTRODUCTION

In alluvial streams, the scour around bridge piers, abutments, and other local obstructions is first initiated by the interference to flow and sediment transport. Figure 1 shows the local around a bridge pier taken soon after a storm flow. SunCatchers will be installed in Washes A and D and F at the Solar Two project site. The pedestal supporting a SunCatcher induces local scour during the storm flow.

Figure 1. Local scour around bridge pier

During a storm flow, local scour is first initiated by the pier's interference to flow and sediment transport as illustrate in Figure 2. The erodible bed deforms until it reaches an equilibrium scour configuration for which the rate of sediment supplied to the scour area is balanced by the rate of transport out of the area, that is, $(Q_s)_{in} = (Q_s)_{out}$. Sediment transport through a scour hole is also affected by the horseshoe vortices, which, as a turbulent motion, increase the particle mobility. The sediment rate is an inverse function of the particle size. Because sediment rates flowing into and out of a scour area change with the size, at nearly the same proportion, the scour depth is not significantly affected by the sediment size which is therefore missing in most formulas for local scour.

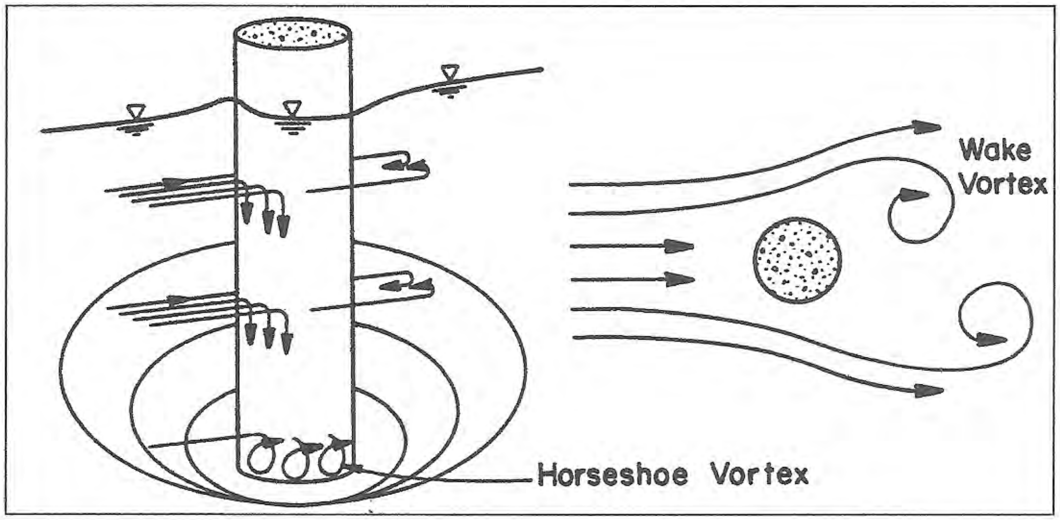


Figure 2. Interference to flow by a pier (After Federal Highway Administration, 2006)

The scour hole shaped like an inverted cone changes in size with the flow, it normally reaches the maximum during the peak flow and it becomes partially refilled during the receding stage of the storm flow.

Different formulas have been developed for predicting local scour around bridge piers. Despite the large number, such formulas contain a limited number of variables, namely, approach flow depth, effective pier width, Froude number, shear stress, and critical shear stress. The Federal Highway Administration (2006) recommends the CSU formula, which was also employed in this study

II. PEDESTALS IN WASH D

For the project site, Wash C is totally avoided by SunCatchers in the wash, as are Washes I, K and portions of E and G in the current revised site plan. Washes A and D and F are impacted by placement of SunCatchers along their entire reach in the current and previously proposed plans. Wash D is selected as the sample to determine the depths and stream bed surface areas affected by the scour around the pedestals.

A total of 465 SunCatchers supported by pedestals will be installed in Wash D. The spacing between SunCatchers is 122 feet in the east-west direction and 58 feet between SunCatchers north to south.

The basic information on the hydraulics of flow in Wash D is required in order to compute the depth of local scour and the area affected by local scour. The hydraulic modeling study for the washes was prepared by Stantec Consulting, Inc. for Stirling Energy Systems, Inc. Figure 3 shows the layout of the channel cross sections used to define the stream channel geometry. A summary of the flow hydraulics for the 100-yr storm from the hydraulic study is listed in Table 1.

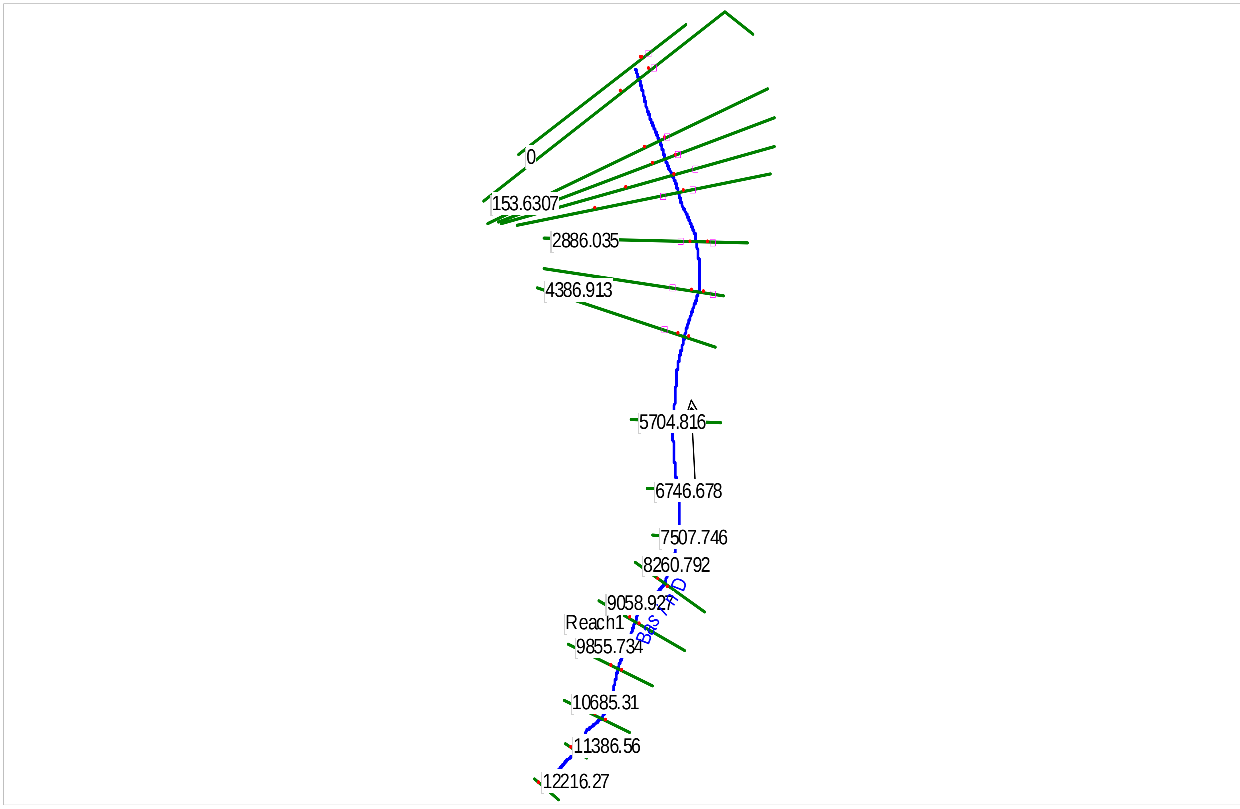


Figure 3. Location of channel cross sections for Wash D

Table 1. Summary of hydraulic parameters for Wash D

River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Vel Chnl (ft/s)	Top Width (ft)	Froude #
12216.27	57.00	292.74	293.50	1.93	87.73	0.55
11386.56	76.00	280.50	281.29	2.81	115.90	1.03
10685.31	92.00	274.20	275.09	0.99	252.09	0.29
9855.734	110.00	270.12	270.53	1.95	409.90	0.81
9058.927	129.00	265.91	266.41	1.10	445.04	0.32
8260.792	147.00	262.17	263.19	1.86	271.17	0.52
7507.746	164.00	255.83	257.64	2.58	113.36	0.61
6746.678	181.00	249.31	250.23	2.81	135.61	0.72
5704.816	205.00	238.00	239.45	2.76	133.44	0.65
4386.913	234.00	222.44	222.96	1.75	411.82	0.73
3656.229	251.00	213.11	214.06	2.76	188.12	0.65
2886.035	268.00	204.00	205.01	2.83	241.91	0.79

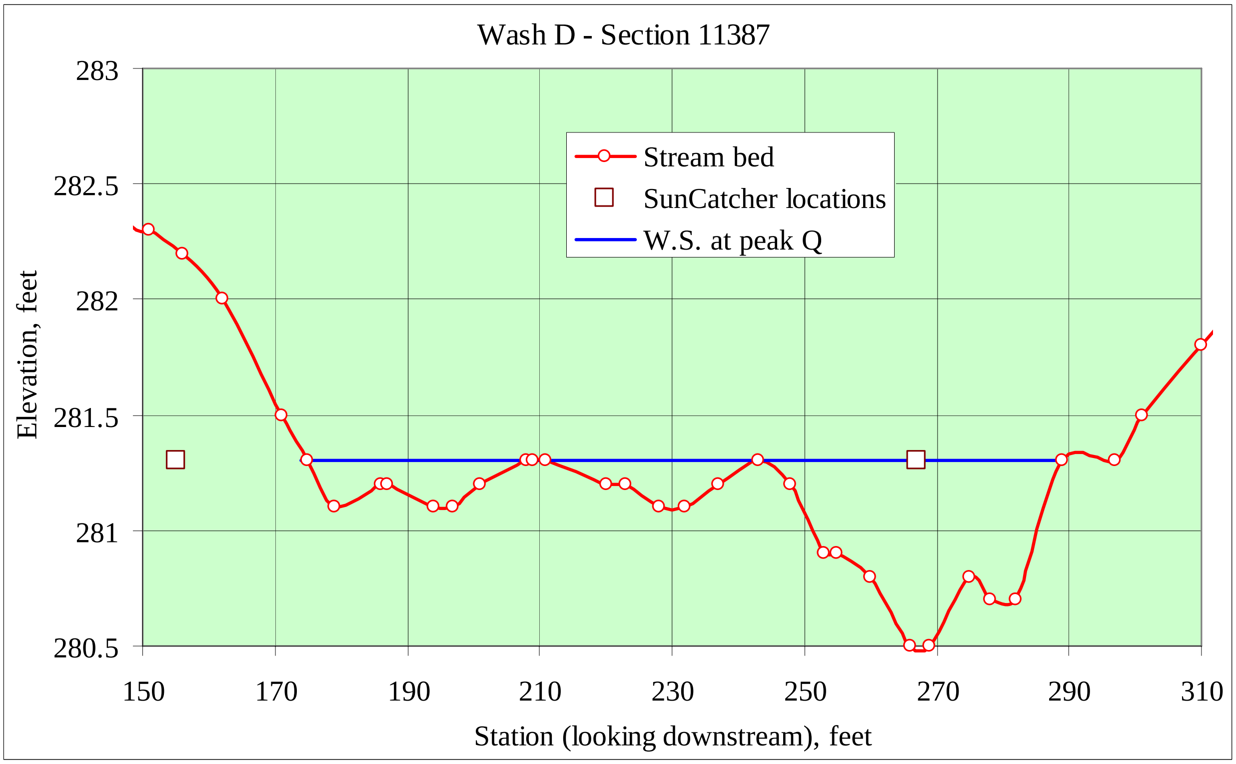
2050.257	287.00	188.10	190.41	4.15	128.80	1.00
1765.222	294.00	184.99	186.25	1.67	407.21	0.45
1484.783	300.00	182.92	183.37	1.07	382.25	0.43
1183.998	307.00	179.68	180.28	2.86	366.07	0.96
153.6307	568.00	167.91	169.60	1.69	390.97	0.32
0	607.00	164.09	167.21	8.92	33.71	0.97

Important data for the channel cross sections are listed below. The water-surface elevation, surface width of flow, and the Froude number are from the hydraulic computations listed in Table 1. The channel sections are oriented primarily in the east-west direction. The number of SunCatchers that can be installed within the surface width of low at a channel section is determined based on the spacing between units along the direction of the channel cross section. The locations of SunCatchers at sample cross sections are shown in the cross-sectional profiles.

Each channel section is assumed to represent the channel reach centered at the section. The number of SunCatcher rows along the channel reach is the reach length divided by the spacing of 58 feet between the SunCatcher rows. The total number of SunCathers in a channel reach is estimated based on the number of SunCathers at the channel section multiplied by the number of SunCatcher rows. The total number of SunCatchers for Wash D is 465.

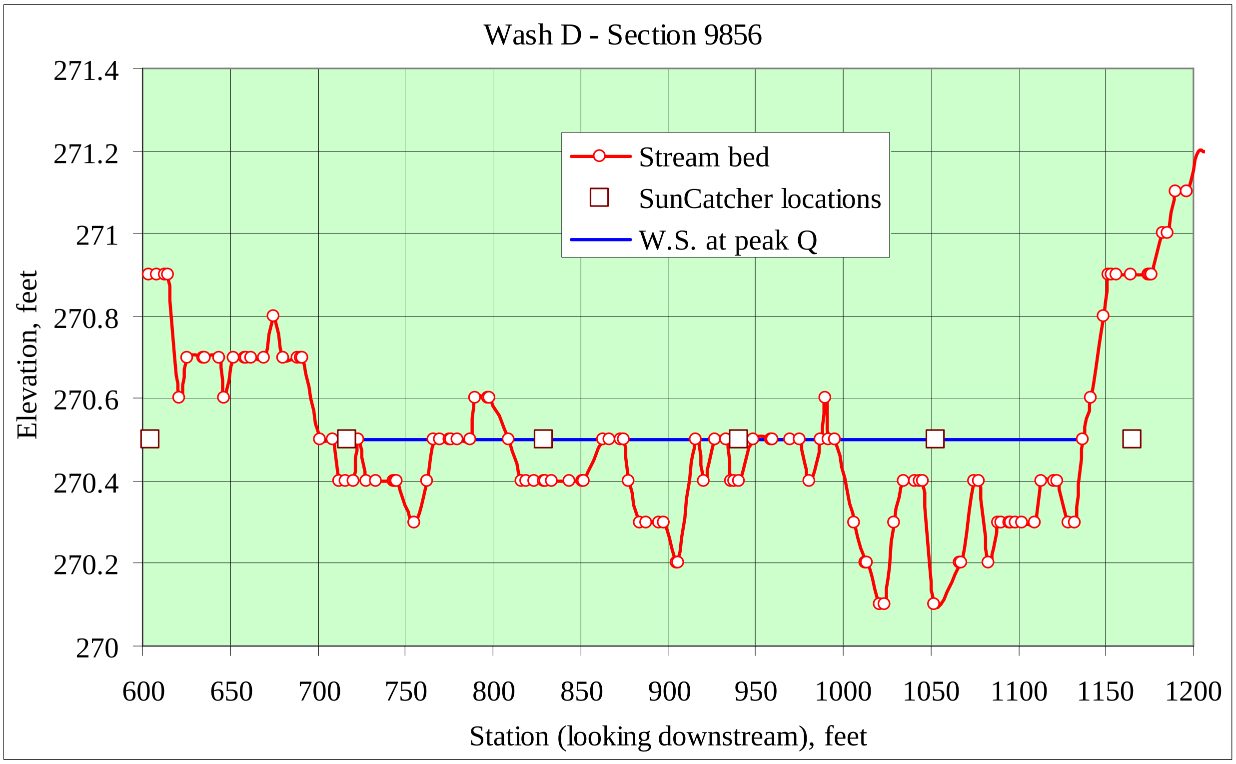
The local scour depth is directly related to the flow depth at the pedestal. To get the maximum local scour, it is assumed that one pedestal is located at the point with the largest depth at a channel section.

Section 11387
Water-surface elevation for 100-yr storm: 281.3 feet
Surface width of flow: 115.9 feet
Number of SunCathers in wash: 1
Length of channel reach: 765.5 feet
Number of SunCatcher rows: 18
Approximate number of SunCatchers in reach: 18



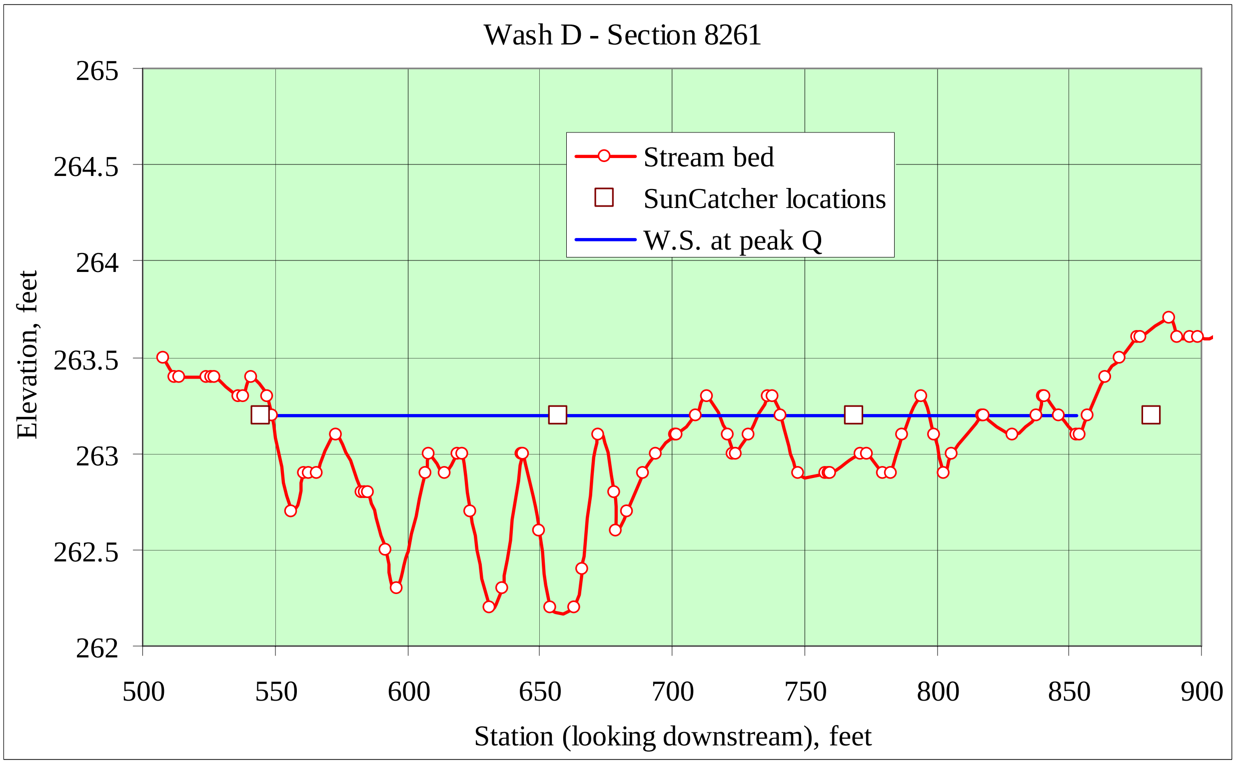
Section 10685
Water-surface elevation for 100-yr storm: 275.1 feet
Surface width of flow: 252.1 feet
Number of SunCathers in wash: 2
Length of channel reach: 765 feet
Number of SunCatcher rows: 12
Approximate number of SunCatchers in reach: 24

Section 9856
Water-surface elevation for 100-yr storm: 270.5 feet
Surface width of flow: 409.9 feet
Number of SunCathers in wash: 3
Length of channel reach: 813 feet
Number of SunCatcher rows: 13
Approximate number of SunCatchers in reach: 39



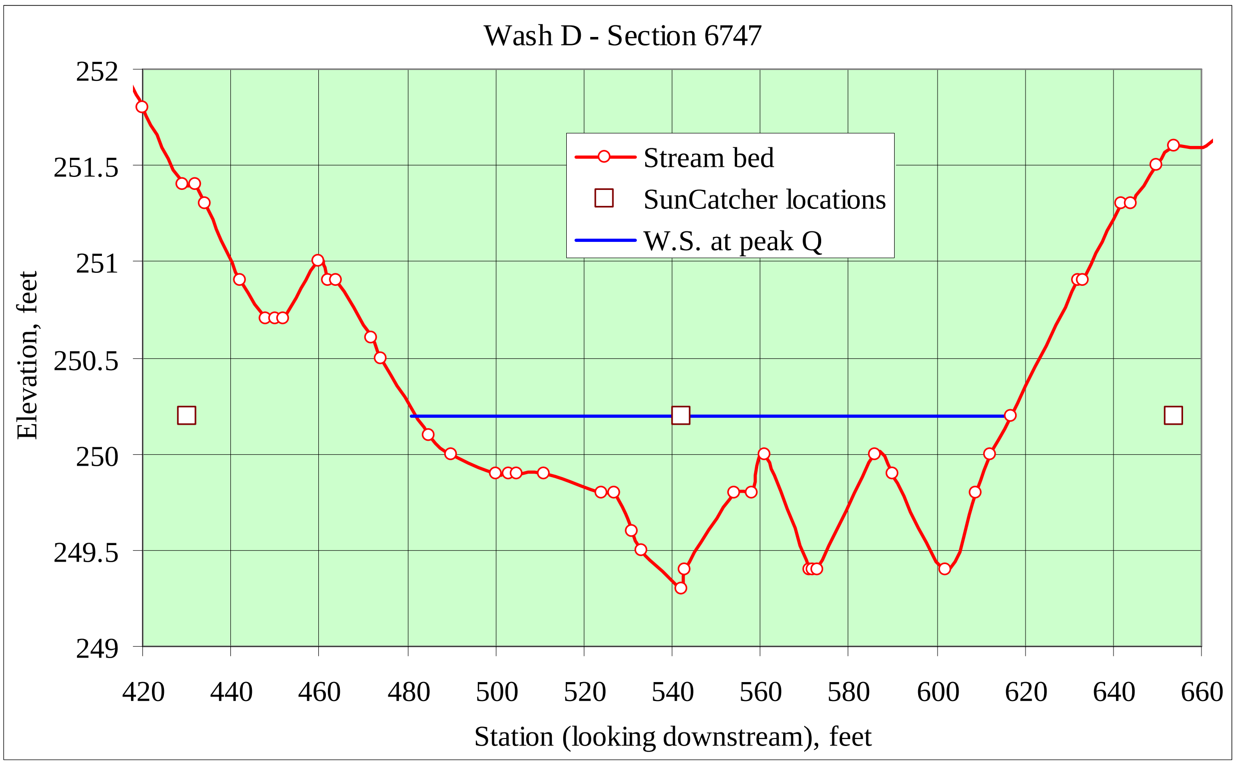
Section 9059
Water-surface elevation for 100-yr storm: 266.4 feet
Surface width of flow: 445.0 feet
Number of SunCathers in wash: 3
Length of channel reach: 797 feet
Number of SunCatcher rows: 14
Approximate number of SunCatchers in reach: 42

Section 8261
Water-surface elevation for 100-yr storm: 263.2 feet
Surface width of flow: 271.2 feet
Number of SunCathers in wash: 2
Length of channel reach: 775 feet
Number of SunCatcher rows: 13
Approximate number of SunCatchers in reach: 26



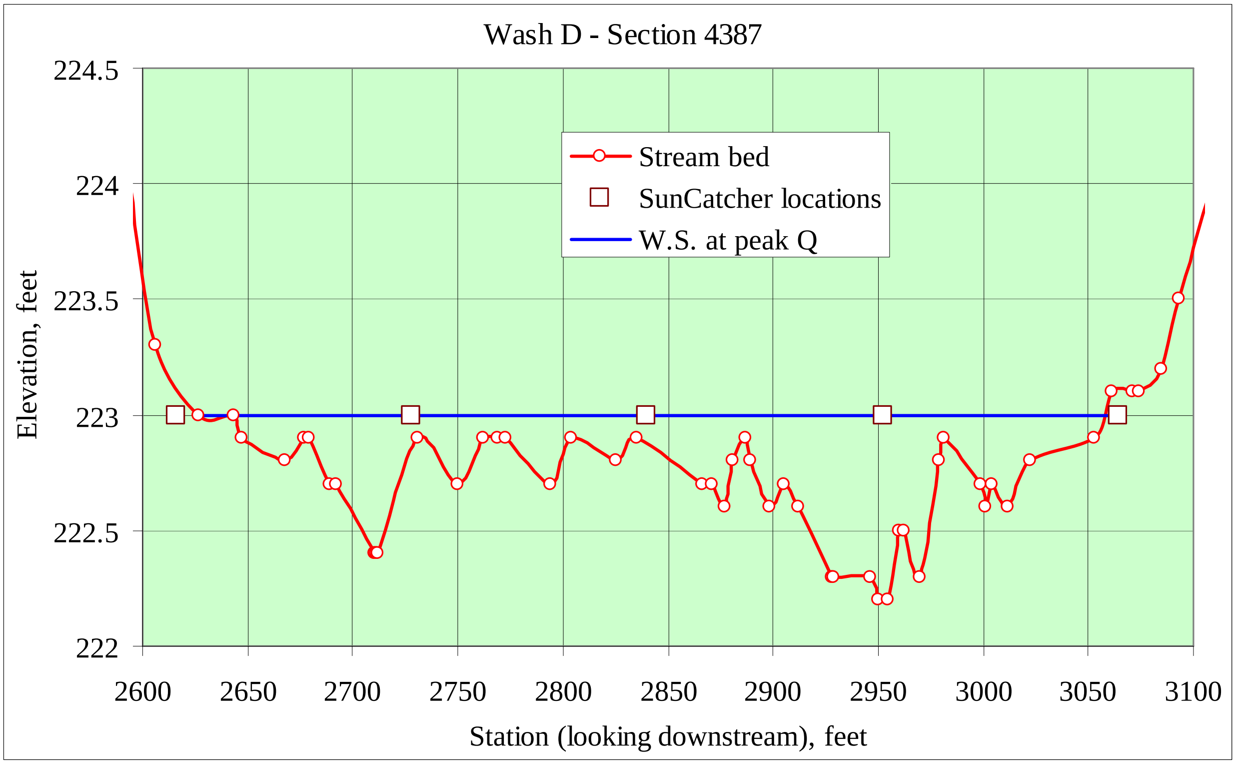
Section 7508
Water-surface elevation for 100-yr storm: 257.6 feet
Surface width of flow: 113.4 feet
Number of SunCathers in wash: 1
Length of channel reach: 757 feet
Number of SunCatcher rows: 12
Approximate number of SunCatchers in reach: 12

Section 6747
Water-surface elevation for 100-yr storm: 250.2 feet
Surface width of flow: 133.6 feet
Number of SunCathers in wash: 2
Length of channel reach: 901 feet
Number of SunCatcher rows: 15
Approximate number of SunCatchers in reach: 30



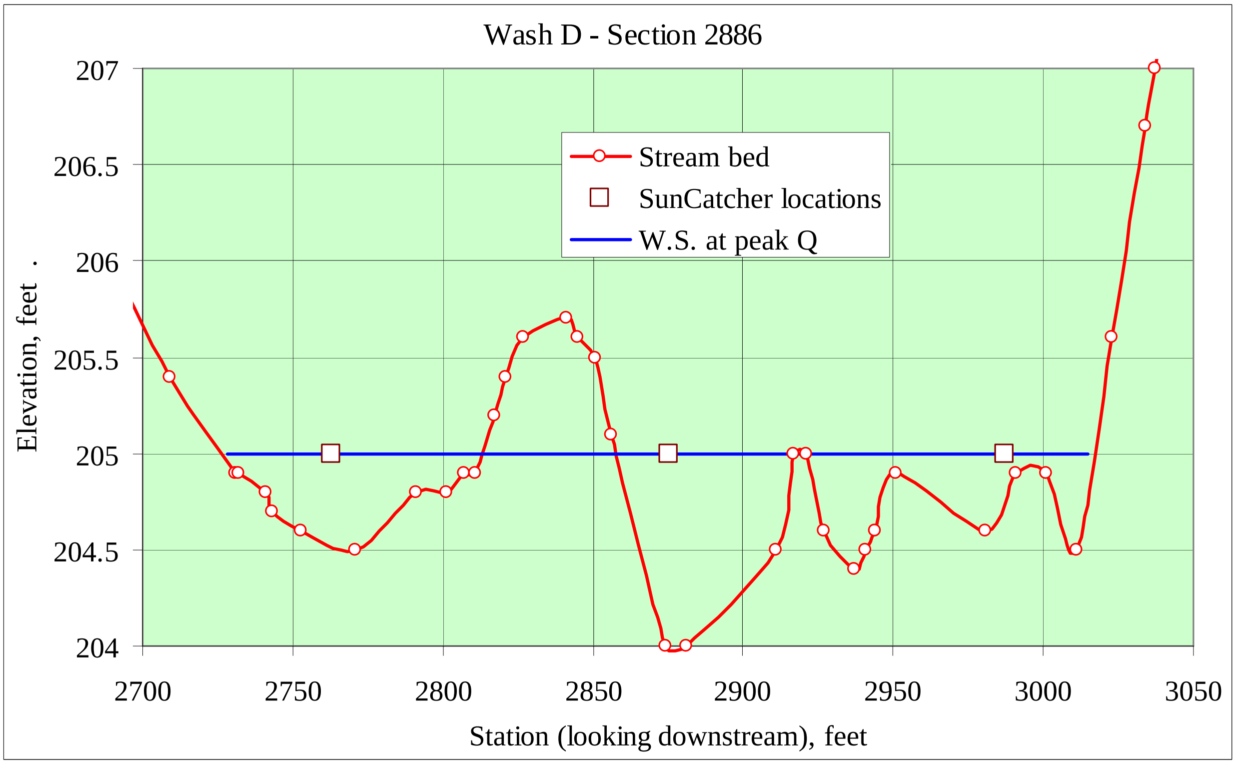
Section 5705
Water-surface elevation for 100-yr storm: 239.5 feet
Surface width of flow: 133.4 feet
Number of SunCathers in wash: 2
Length of channel reach: 1180 feet
Number of SunCatcher rows: 20
Approximate number of SunCatchers in reach: 40

Section 4387
Water-surface elevation for 100-yr storm: 223.0 feet
Surface width of flow: 411.8 feet
Number of SunCathers in wash: 3
Length of channel reach: 1024 feet
Number of SunCatcher rows: 17
Approximate number of SunCatchers in reach: 51



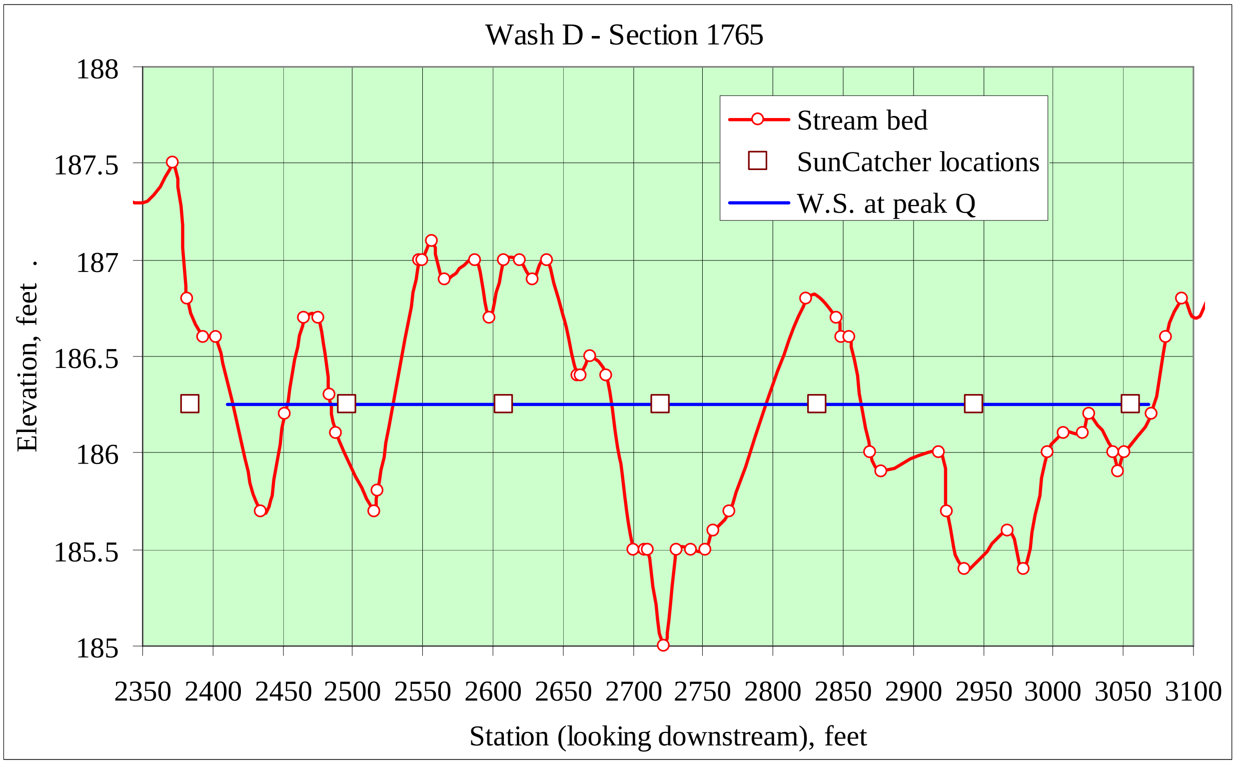
Section 3656
Water-surface elevation for 100-yr storm: 214.1 feet
Surface width of flow: 188.1 feet
Number of SunCathers in wash: 1
Length of channel reach: 751 feet
Number of SunCatcher rows: 13
Approximate number of SunCatchers in reach: 13

Section 2886
Water-surface elevation for 100-yr storm: 205.0 feet
Surface width of flow: 241.9 feet
Number of SunCathers in wash: 2
Length of channel reach: 803 feet
Number of SunCatcher rows: 14
Approximate number of SunCatchers in reach: 28



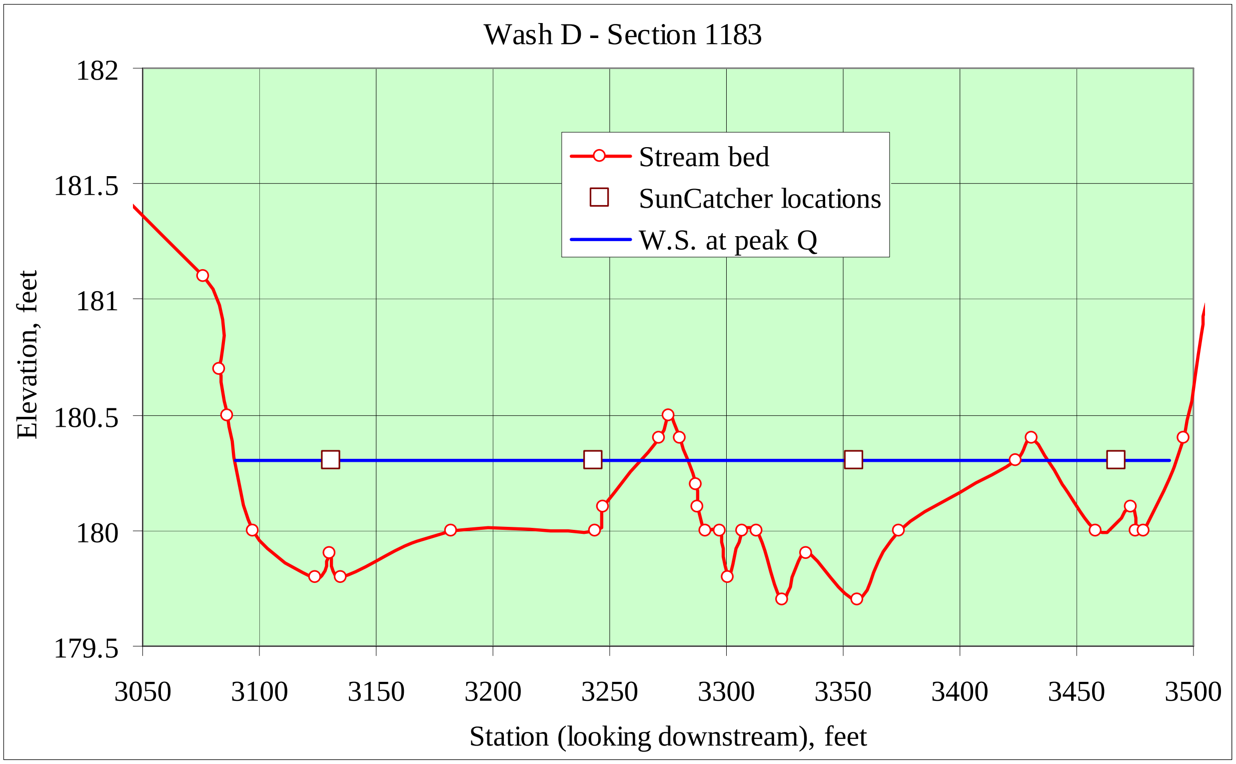
Section 2050
Water-surface elevation for 100-yr storm: 190.4 feet
Surface width of flow: 129 feet
Number of SunCathers in wash: 1
Length of channel reach: 500 feet
Number of SunCatcher rows: 9
Approximate number of SunCatchers in reach: 9

Section 1765
Water-surface elevation for 100-yr storm: 186.3 feet
Surface width of flow: 407.2 feet
Number of SunCathers in wash: 3
Length of channel reach: 283 feet
Number of SunCatcher rows: 4
Approximate number of SunCatchers in reach: 12



Section 1484.8
Water-surface elevation for 100-yr storm: 183.4 feet
Surface width of flow: 382.3 feet
Number of SunCathers in wash: 4
Length of channel reach: 290.6 feet
Number of SunCatcher rows: 5
Approximate number of SunCatchers in reach: 20

Section 1183.9
Water-surface elevation for 100-yr storm: 180.28
Surface width of flow: 366.1 feet
Number of SunCathers in wash: 4
Length of channel reach: 665 feet
Number of SunCatcher rows: 665/58 = 11.5
Approximate number of SunCatchers in reach: 11.5 x 4 = 66



Section 154
Water-surface elevation for 100-yr storm: 169.6
Surface width of flow: 391 feet
Number of SunCathers in wash: 3
Length of channel reach: 591 feet
Number of SunCatcher rows: 10
Approximate number of SunCatchers in reach: 30

III. COMPUTATION OF LOCAL SCOUR AROUND PEDESTALS IN WASH D

Local Scour at Bridge Piers/Bents - The magnitude of local scour around a pedestal may be estimated using certain established formulas. The Federal Highway Administration has adopted the following equation (see Hydraulic Engineering Circular No. 18, FHWA, 2006) for round-nosed piers/bents or cylindrical piers/bents.

$$Y_s/Y_1 = 2.0\ K_1\ K_2\ (b/Y_1)^{0.65}\ F^{0.43} \qquad (1)$$

where Y = depth of local scour measured from the mean bed elevation, in feet;
K_1 = correction for pier/bent nose shape, equal to 1 for circular piers/bents and 1.1 for rectangular piers/bents;
K_2 = correction factor for angle of attack, equal to 1 for zero skew;
b = projected pier/bent width;
Y_1 = approach flow depth;
F = Froude number = $V//gY_1$; and
V = velocity of approach flow.

Local scour depths and areas affected by local scour were computed for the sample cross sections shown above. The required hydraulic data used in the computation are from the listed values in Table 1. The local depths of flow at the individual pedestals are shown in the figures for the sample cross sections.

The depths of local scour at the pedestals were computed using Equation 1. The computation for the area affected by scour is illustrated by the numerical example given below for the assumed local scour depth of 2.9 feet. The angle of repose for the bed material is assumed to be 36 degrees and the pedestal diameter is 2 feet.

For the scour depth of 2.9 feet and angle of repose of 36 degrees:
Horizontal distance due to the scour depth = 2.9/tan 36 = 3.99 feet
Radius of scour hole measured from the center of pedestal = 1+ 3.99 = 4.99
Diameter of pedestal = 2 feet
Cross-sectional area of pedestal = 3.14 square feet
Area of scour hole = 3.14 x 4.99^2 – 3.14 = 78.18 – 3.14 = 75.0 square feet

The depth of scour is directly related to the depth of flow. For this reason, the maximum scour occurs near the peak flow and it gets partially refilled during the falling stage of the storm flow. The scour hole becomes smaller at the end of the storm. It is assumed that the scour depth is 50% refilled toward the end of the storm follow; the area affected by scour decreases with the depth of scour. The hydraulic parameters together with the computed results for scour depths and areas affected by scour are summarized in Table 2 below:

Table 2. Summary of hydraulic parameters and computed results for local sour.

Section . No. Number	Froude Number	Local Flow Depth	Maximum Scour Depth	Maximum Scour Area	Final Scour Area
11387	1.03	0.82	2.97	78.0	33.6
9856	0.81	0.26	1.79	34.5	18.2
9856	0.81	0.26	1.79	34.5	18.2
9856	0.81	0.26	1.79	34.5	18.2
9856	0.81	1.03	2.90	75.0	32.6
8261	0.52	1.03	2.39	54.8	25.6
8261	0.52	0.19	1.32	21.9	13.3
6747	0.72	0.87	2.60	62.6	28.3
4387	0.73	0.12	1.31	21.4	13.1
4387	0.73	0.15	1.41	24.1	14.2
4387	0.73	0.79	2.52	59.8	27.3
2886	0.79	0.45	2.14	45.9	22.4
2886	0.79	1.03	2.87	73.7	32.1
2886	0.79	0.27	1.79	34.7	18.3
1765	0.45	0.26	1.39	23.5	14.0
1765	0.45	1.27	2.42	55.8	26.0
1765	0.45	0.77	2.03	42.2	21.1
1765	0.45	0.20	1.27	20.5	12.8
1183	0.96	0.40	2.24	49.2	23.6
1183	0.96	0.30	2.02	41.9	21.0
1183	0.96	0.58	2.55	60.7	27.7
1183	0.96	0.25	1.90	37.9	19.5

Summary of Computed Results – The computed results for Wash D are summarized below:

Maximum flow depth around pedestals = 1.27 feet
Maximum scour depth around pedestals = 2.97 feet
Range of scour depths around pedestals during peak 100-yr storm = 1.31 feet to 2.97 feet
Range of scour depths around pedestals at end of 100-yr storm= 0.66 feet to 1.49 feet

Maximum area affected by scour during peak 100-yr storm= 78.0 square feet
Range of area affected by scour during peak 100-yr storm = 20.5 to 78.0 square feet
Range of area affected by scour at end of 100-yr storm = 12.8 to 33.6 square feet

Average maximum scour area during peak 100-yr storm = 44.86 square feet
Average area affected by scour at end of 100-yr storm = 21.87 square feet

Number of pedestals in Wash D = 465
Total maximum scour area = 44.86 x 465 = 20,860 square feet
Total scour area at end of storm 21.87 x 465 = 10.167 square feet
Land surface area of Wash D covered by 100-yr storm = 3,090,000 square feet
= 70.93 acres

Ratio of maximum scour area to total wash area = 0.00675 = 0.675%
Ratio of end of storm scour area to total wash area = 0.00329 = 0.329 %

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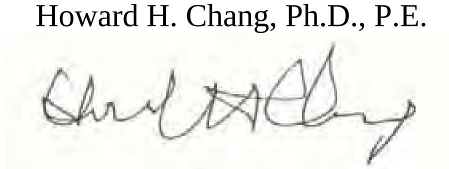
Evaluation of Engineering Impacts of Revised Plan of Development, Site Plan, and Fencing Design for Solar 2 Site and Recommendations for Impact Mitigation

Submitted to

Mike Fitzgerald
Principal
Ecosphere Environmental Services
Durango, CO

Prepared by
Howard H. Chang, Ph.D., P.E.



May 19, 2010

EXECUTIVE SUMMARY

Ecosphere Environmental Services has revised the original Plan of Development (POD) for the Solar Two project site in Imperial Valley. The revised POD as shown in Figure 1 has the following major features:

(1) The original solar energy project site is expanded to the north of the transmission corridor along Washes E, F, and G.
(2) The detailed placement of the solar catchers is shown the site plan. Many such units are located in washes.
(3) Within each generator group, the solar catchers are connected by maintenance roads, which are at grade and unpaved.
(4) All sediment basins have been removed.
(5) All road crossings are Arizona at grade crossings with the exception of 2 “life line” road crossings. The two “life line” road crossings will either remain culvert crossings or, more likely, a precast concrete arched culvert system (like a bridge); and vegetation clearing is minimized (approach described in revised POD).
(6) The project site will be surrounded by a fence.

The hydraulics of storm flow, sediment transport and potential stream channel changes along several representative washes at the project site were modeled in my previous study for the project. The flow depths in the washes at the peak 100-yr flood were determined to be generally less than 1 foot. The velocities at the 100-yr peak flood discharge vary from low to moderate; they are generally lower than 3 feet per second. From the sediment modeling study, it was determined that these washes are not subject to substantial changes in channel bed profiles for the existing and proposed conditions. Because of these findings, it was decided that the solar catchers may be placed in the washes.

The solar units are supported on 2-foot cylindrical pedestals. For a pedestal in a wash, the maximum scour, including general scour and local scour, was determined be no greater than 5 feet. According to the structural design, the pedestals are imbedded into the ground for a length of 17 feet. Such a footing design is considered adequate to safeguard the structure against potential scour.

The revised POD was also evaluated in consideration of the necessary mitigation measures that I recommended previously. The sediment study provides an assessment of whether the project is likely to increase or decrease sediment delivery toward downstream. In order to minimize the impacts, the project should cause no substantial changes to the sediment delivery. Sediment impacts are mitigated by the following measures incorporated in the POD:

(1) Deletion of all sediment basins.
(2) Modification of Lifeline Crossing in Wash G.
(3) Set-back of at least 100 feet for the solar units along the base of the hills.

In summary, the revised POD has incorporated measures to comply with my recommendations made for the project site in order to mitigate the project impacts. The revised POD has also provided necessary design feature for the pedestals of solar catchers located in washes for scour protection. In consideration of these points, the revised POD meets the requirements stated in my previous studies for the project site.

I. INTRODUCTION

The proposed Solar Two Project is on the Bureau of Land Management property south of Plaster City in Imperial County, California. The Evan Hewes Highway is the north boundary and Interstate 8 is the south boundary of the project site. Hydrology of surface water runoff plays a key role in the desert ecosystem of the southwestern United States. For this reason, many environmental issues for the project must be analyzed from the perspective of hydrology. As a consultant, I provided studies of hydrologic impacts as well as sediment studies for the project site. Mitigation measures for project impacts have also been recommended.

Ecosphere Environmental Services has revised the original Plan of Development (POD) for the project site. Figure 1 is a wash impact avoidance/minimization site plan that Ecosphere Environmental Services have been working with the Corps and EPA on to finalize as the least environmentally damaging practicable alternative (LEDPA). The revised POD was developed in consideration of my previous recommendations. The revised POD as shown in the figure has the following major features:

(1) The project site is crossed by a transmission line. The original solar energy project site was south of the transmission line. It is now extended to the north of the transmission corridor along Washes E, F, and G.
(2) The detailed placement of solar catchers is shown the POD. Many such units are located in washes.
(3) Within each generator group, the solar catchers are connected by maintenance roads, which are at grade and unpaved.
(4) All sediment basins have been removed.
(5) All road crossings are Arizona at grade crossings with the exception of 2 “life line” road crossings. The two “life line” road crossings will either remain culvert crossings or, more likely, a precast concrete arched culvert system (like a bridge); and vegetation clearing is minimized (approach described in revised POD).
(6) The project site will be surrounded by a fence.

This report has been prepared to provide a qualitative assessment of potential engineering impacts of the revised POD for the Solar Two Energy Project site. In connection with the review and evaluation, a one-day site visit was made on May 10, 2010. This report covers the following major items:

(1) Review and comment on revised Plan of Development (POD) and site plan – The consultant made a hydrology and sediment study for the solar energy site. In connection with the study, specific recommendations were also made for project impact mitigation. The consultant has reviewed the revised POD and site pan to insure recommendations are fulfilled. Necessary changes, if any, to the POD and site plan are specified.

(2) Review the fencing design and make design recommendations – The perimeter fencing is along the entire border of the project site. It will cross ephemeral drainages. The fencing design has potential impacts on surface water flow and sediment transport. The EPA is concerned about obstructing natural flows and the resulting effects of sediment transfer. Such potential impacts will be evaluated and specific recommendations will be made for the purpose of impact mitigation.

F

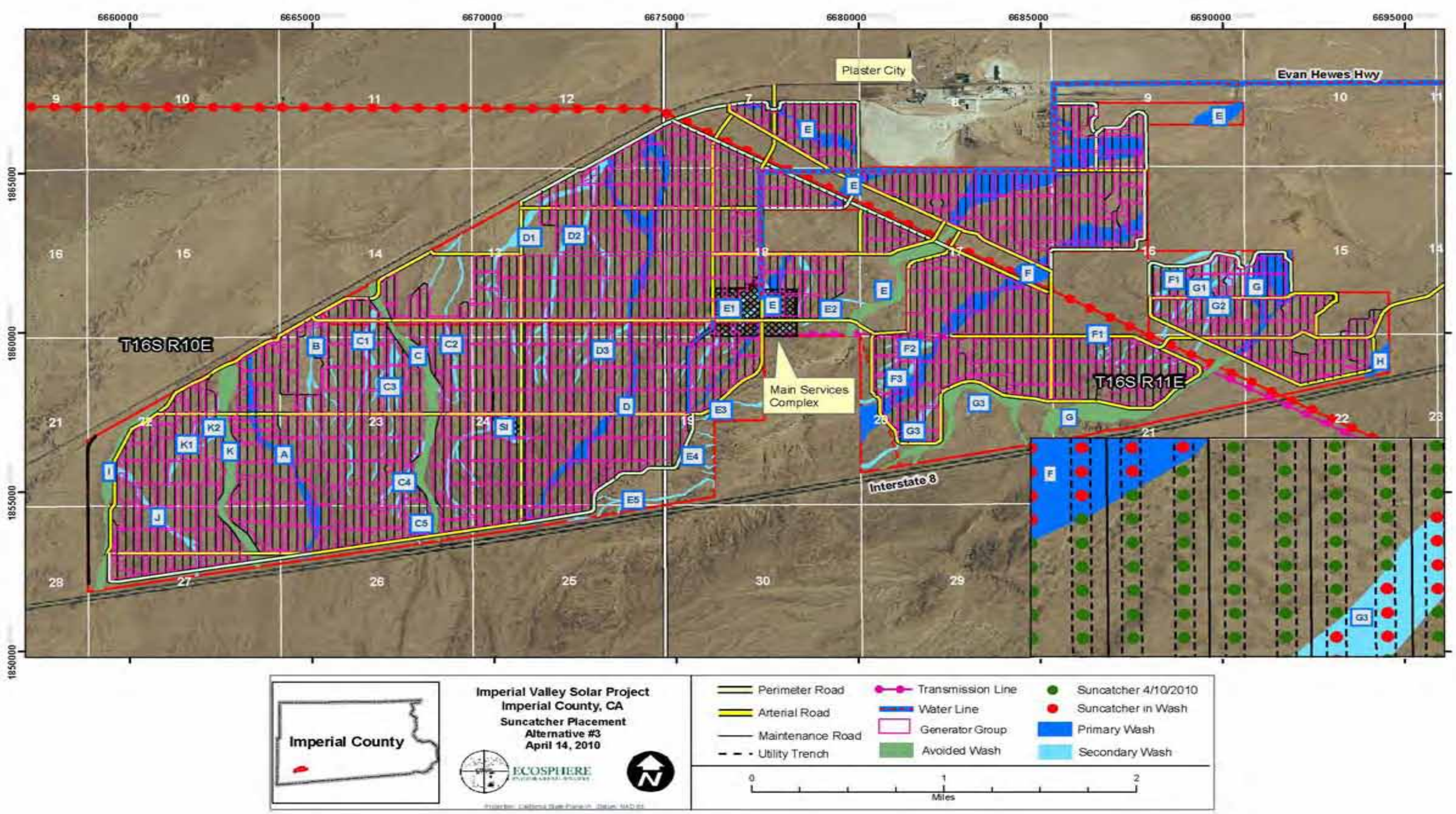


Figure 1. Revised Plan of Development (POD) site plan by Ecosphere Environmental Services

II. COMMENT ON THE REVISED PLAN OF DEVELOPMENT

Storm flows in the desert generally occur as flash floods with the discharge rising and falling rapidly. The hydraulics of storm flow, sediment transport and potential stream channel changes along several representative washes at the project site were modeled in my previous study for the project. The flow depths in the washes at the peak 100-yr flood were determined to be generally less than 1 foot. The velocities at the peak flood discharge vary from low to moderate; they are generally lower than 3 feet per second. From the sediment modeling study, it was determined that these washes are not subject to substantial changes in channel bed profiles for the existing and proposed conditions. Changes in bed elevation due to general scour are less than 1 foot during the 100-yr flood. Such changes are even less during the 10-yr flood. Because of these findings, it was decided that the solar catchers may be placed in the washes.

The solar units are supported on 2-foot cylindrical pedestals. For a pedestal in a wash, the total scour is the general scour plus the local scour at the pedestal base. The maximum local scour that occurs under the worst combination of flow depth and flow velocity has been computed to be 4.2 feet during the 100-yr flood. The maximum scour, including general scour and local scour, was determined be no greater than 5 feet. According to the structural design, the pedestals are imbedded into the ground for a length of 17 feet. Such a footing design is considered adequate to safeguard the structure against potential scour.

As a first step, the revised POD was evaluated in consideration of the necessary mitigation measures that I recommended previously. The sediment study provides representative sediment transport modeling to assess potential stream channel changes as well as an assessment of whether the project is likely to increase or decrease sediment delivery toward downstream. It is necessary to determine consequences of increased or decreased sediment delivery downstream. Possible consequences could include excess sediment deposition upstream of the existing railroad and culvert crossings along the north side of the project, or excess sediment delivery toward the east and the Westside Main Canal, or downstream channel degradation affecting existing infrastructure and channel morphology. In order to minimize the impacts, the project should cause no substantial changes to the sediment delivery. Otherwise, adverse impacts should be mitigated.

Sediment impacts may be mitigated by different methods. Basically, the road crossings, sediment basins, culverts, vegetation, buildings, etc. all affect sediment transport. In order to mitigate adverse impacts, modifications to these structures are considered. Based on the results of this study, the following mitigations for project impacts were recommended:

(3) Deletion of all sediment basins – The study has shown that the sediment basins will have short-term and long-term effects in reducing sediment flow along a wash and toward downstream. It is recommended all sediment basins be deleted from the proposed plan.

(4) Modification of Lifeline Crossing in Wash G – Under the original proposed plan, the 24-foot Lifeline Crossing has five 3-foot culverts for cross drainage. The top of roadway is about 5 feet above the channel bed elevation. This road crossing together with the two adjacent sediment basins will have major effects in reducing sediment flow along the stream channel. It is recommended that this crossing be changed into an at-grade road

crossing with all the culverts removed. Another alternative is to replace the road crossing with a large culvert or a small bridge that does not interfere with the flow.

(5) Set-back of at least 100 feet for the solar units along the base of the hills.

The first two items are now incorporated in the revised POD. For the third item, the most significant hills are located in the southern part of Basin E just north of Interstate 8. There are small streams coming out of the steep hillside. Alluvial fan formation at the base of the hills is possible. However, these small steep streams have very small watersheds. For this reason, there can be no major flow to cause large alluvial fan formation in this area of the project site. To insure safety of the solar units, it was recommended that a minimum setback of 100 feet be applied to the units along base of the hills. In the exhibit shown in Figure 2 below, the blue line marks the setback limit. Solar units should stay outside the boundary enclosing the hills. The recommended area of exclusion is from the consideration of hydrology. The revised POD complies with this recommendation.

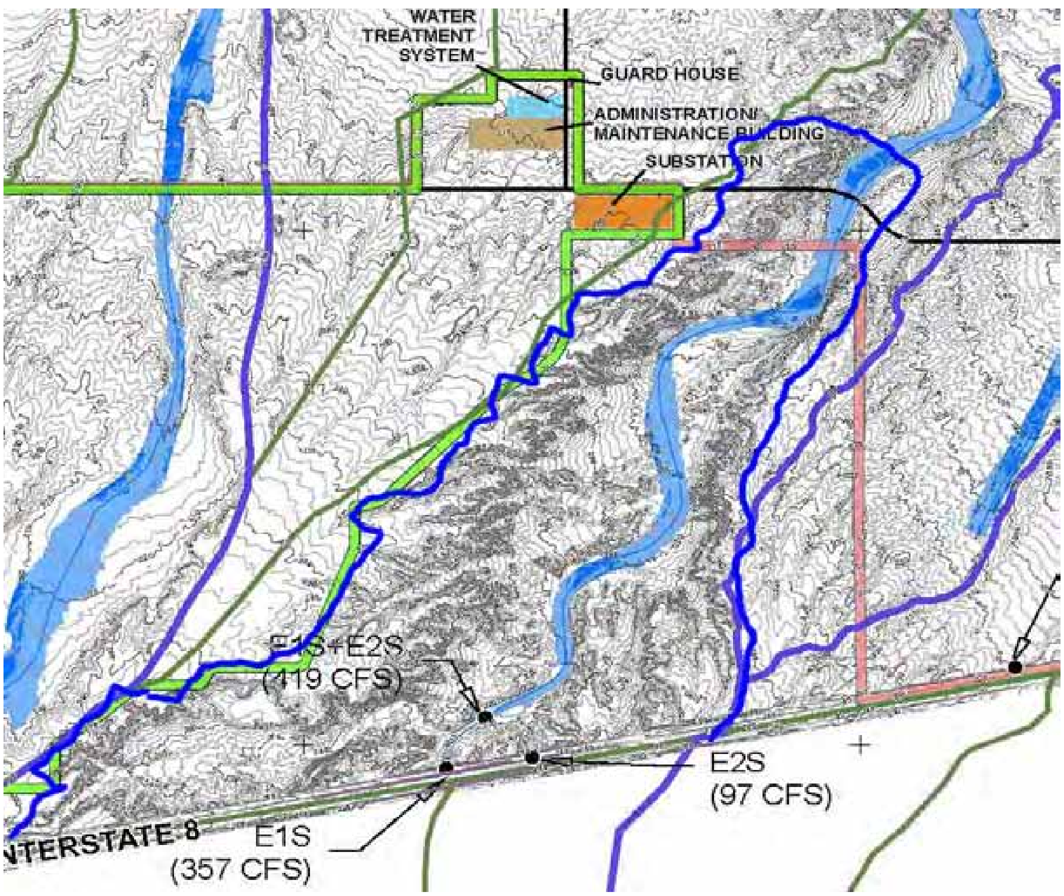


Figure 2. Blue line boundary to exclude inside area for solar units

II. AREAS IN REVISED POD NOT COVERED IN PREVIOUS STUDIES

The revised POD consists of areas for the Solar Two project that are not covered in my previous studies. Such areas are located north of the transmission line and south of Evan Hewes Highway. As shown in Figure 1, these areas are drained by three major washes E, F, and G and several smaller ones. In order to assess the hydrologic impacts on the solar units without any quantitative evaluation, these reaches are compared with their upper reaches south of the transmission line that have been evaluated previously.

Field inspections were made on May 10, 2010 of the washes north the of transmission corridor. Pictures of these washes are shown in Figures 3 for Wash E, in Figure 4 for Wash F, and in Figure 5 for Wash G. These washes are on flat terrains with wide and shallow channels. These lower reaches are generally flatter and wider than the upper reaches south of the transmission corridor.

Storm flows in the desert generally occur as flash floods with the discharge rising and falling rapidly. The flow depths in the washes at the peak 100-yr flood have been determined to be generally less than 1 foot. The velocities at the peak flood discharge vary from low to moderate; they are generally lower than 3 feet per second.

From the sediment modeling study, it was determined that these washes are not subject to substantial changes in channel bed profiles for the existing and proposed conditions. Changes in bed elevation due to general scour are less than 1 foot during the 100-yr flood. Such changes are even less during the 10-yr flood. The solar units are supported on 2-foot cylindrical pedestals. For a pedestal in a wash, the total scour is the general scour plus the local scour at the pedestal base. The maximum local scour that occurs under the worst combination of flow depth and flow velocity has been computed to be 4.2 feet during the 100-yr flood. In view of the stream morphology, the lower wash reaches have slightly lower flow velocities and hence present no significant potential hazard for solar units.

Figure 3. Views of Wash E from the transmission corridor.
The upper picture is a view of Wash E toward upstream.
The lower picture is a view of Wash E toward downstream.

Figure 4. Views of Wash F from the transmission corridor.
The upper picture is a view of Wash F toward upstream.
The lower picture is a view of Wash F toward downstream.

Figure 5. Views of Wash G from the transmission corridor.
The upper picture is a view of Wash G toward south.
The lower picture is a view of Wash G toward downstream.

III. BORDER FENCE DESIGN RECOMMENDATIONS

A fence surrounding the entire project site has been planned. The conceptual design of the fence has not been provided, but it is believed to be tall enough to prevent human passage. It may be a fence with horizontal and vertical steel bars, or a chain link fence. In order to protect the project site, the fence should not allow human passage. The fence will cross certain washes. Depending on the design, the fence may have impacts on surface water flow and sediment transport in the washes.

In order to avoid impacts on the flow and sediment transport, the following features are recommended for fence design:

(1) The steel bar fence is less likely to capture debris carried by the flow, and hence it is considered more desirable than the chain link fence.
(2) At a wash crossing, the bottom of the fence should maintain a clearance of 1 about foot from the stream bed. The 1-foot clearance will pass the 100-yr storm with minimum interference since the flow depth of the 100-yr storm has been determined be about 1 foot.
(3) At a wash crossing, the vertical bars of the fence should maintain a span of at least 8 feet. The vertical bars interfere with the surface water flow. Major interference to flow can be avoided if the spacing between two adjacent bars is at least 8 feet.

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Evaluation of Engineering Impacts of Revised Plan of Development, Site Plan, and Fencing Design for Solar 2 Site and Recommendations for Impact Mitigation

Submitted to
Ecosphere Environmental Services
Durango, CO

Prepared by
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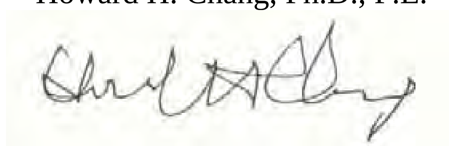

May 25, 2010

EXECUTIVE SUMMARY

Ecosphere Environmental Services has revised the original Plan of Development (POD) for the Solar Two project site in Imperial Valley. The revised POD as shown in Figure 1 has the following major features:

(1) The original solar energy project site is expanded to the north of the transmission corridor along Washes E, F, and G.
(2) The detailed placement of the solar catchers is shown the site plan. Many such units are located in washes.
(3) Within each generator group, the solar catchers are connected by maintenance roads, which are at grade and unpaved.
(4) All sediment basins have been removed.
(5) All road crossings are Arizona at grade crossings with the exception of 2 "life line" road crossings. The two "life line" road crossings will either remain culvert crossings or, more likely, a precast concrete arched culvert system (like a bridge); and vegetation clearing is minimized (approach described in revised POD).
(6) The project site will be surrounded by a fence.

The hydraulics of storm flow, sediment transport and potential stream channel changes along several representative washes at the project site were modeled in my previous study for the project. The flow depths in the washes at the peak 100-yr flood were determined to be generally less than 1 foot. The velocities at the 100-yr peak flood discharge vary from low to moderate;

they are generally lower than 3 feet per second. From the sediment modeling study, it was determined that these washes are not subject to substantial changes in channel bed profiles for the existing and proposed conditions. Because of these findings, it was decided that the solar catchers may be placed in the washes.

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The revised POD was also evaluated in consideration of the necessary mitigation measures that I recommended previously. The sediment study provides an assessment of whether the project is likely to increase or decrease sediment delivery toward downstream. In order to minimize the impacts, the project should cause no substantial changes to the sediment delivery. Sediment impacts are mitigated by the following measures incorporated in the POD:

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In summary, the revised POD has incorporated measures to comply with my recommendations made for the project site in order to mitigate the project impacts. The revised POD has also provided necessary design feature for the pedestals of solar catchers located in washes for scour protection. In consideration of these points, the revised POD meets the requirements stated in my previous studies for the project site.

I. INTRODUCTION

The proposed Solar Two Project is on the Bureau of Land Management property south of Plaster City in Imperial County, California. The Evan Hewes Highway is the north boundary and Interstate 8 is the south boundary of the project site. Hydrology of surface water runoff plays a key role in the desert ecosystem of the southwestern United States. For this reason, many environmental issues for the project must be analyzed from the perspective of hydrology. As a consultant, I provided studies of hydrologic impacts as well as sediment studies for the project site. Mitigation measures for project impacts have also been recommended.

Ecosphere Environmental Services developed the initial Plan of Development (POD) as shown in Figure 1a. The plan has since been revised and the revised POD is shown in Figure 1b. The major differences between the two PODs is the moved Main Services Complex and the SunCatchers that had to move to accommodate the complex to the north of its location below. Figures 1a and 1b provide the wash impact avoidance/minimization site plan that Ecosphere Environmental Services have been working with the Corps and EPA on to finalize as the least environmentally damaging practicable alternative (LEDPA). The revised POD was developed in consideration of previous recommendations. The revised POD as shown in the figure has the following major features:

(1) The project site is crossed by a transmission line. The original solar energy project site

was south of the transmission line. It is now extended to the north of the transmission corridor along Washes E, F, and G.

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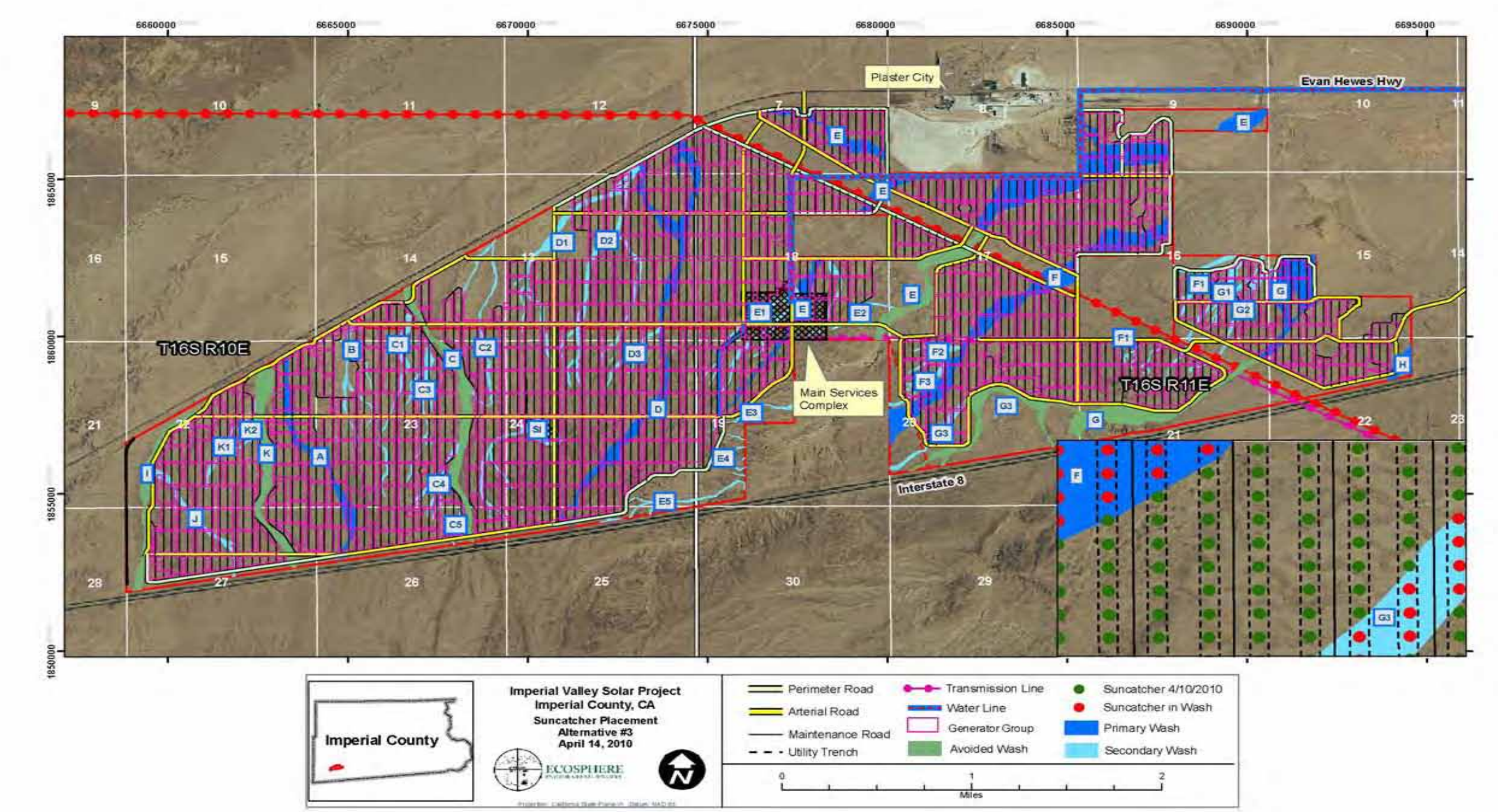

Figure 1a. Initial Plan of Development (POD) site plan by Ecosphere Environmental Services

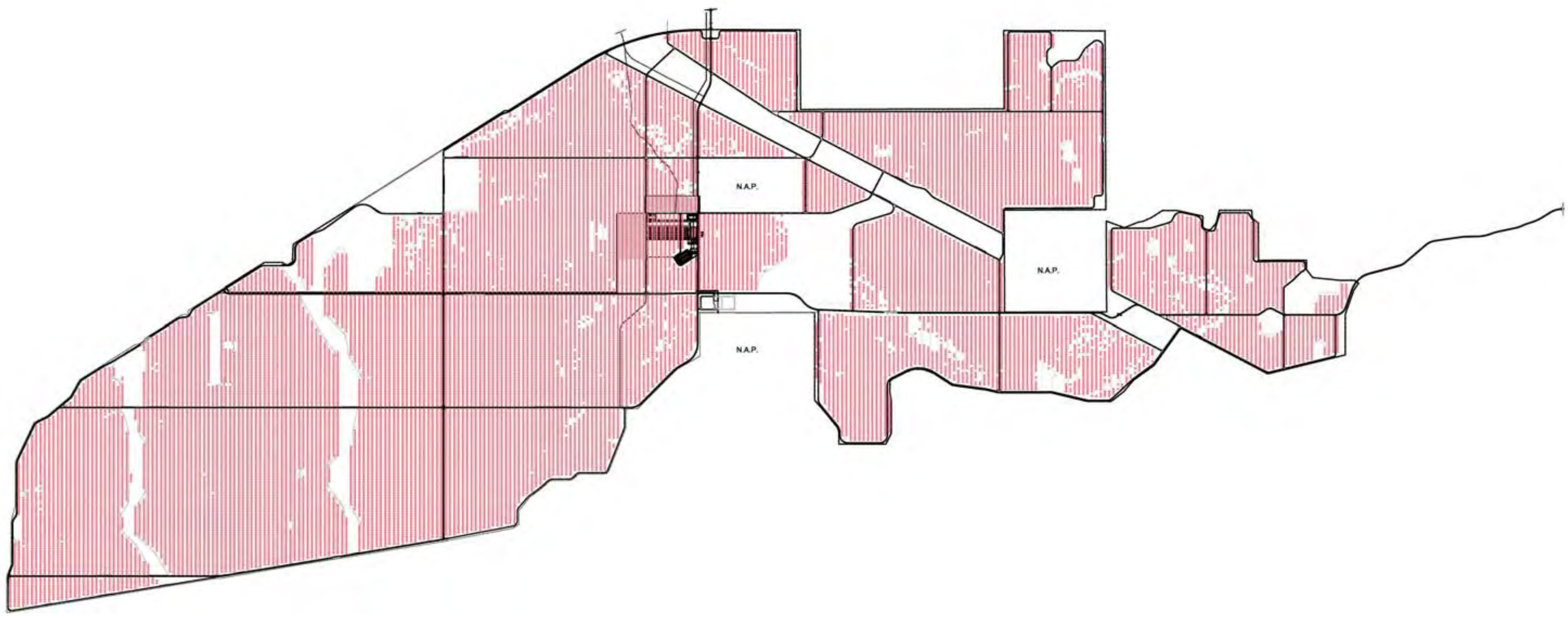

Figure 1b. Revised Plan of Development (POD) site plan by Ecosphere Environmental Services

II. COMMENT ON THE REVISED PLAN OF DEVELOPMENT

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The first two items are now incorporated in the revised POD. For the third item, the most significant hills are located in the southern part of Basin E just north of Interstate 8. There are small streams coming out of the steep hillside. Alluvial fan formation at the base of the hills is possible. However, these small steep streams have very small watersheds. For this reason, there can be no major flow to cause large alluvial fan formation in this area of the project site. To insure safety of the solar units, it was recommended that a minimum setback of 100 feet be applied to the units along base of the hills. In the exhibit shown in Figure 2 below, the blue line marks the setback limit. Solar units should stay outside the boundary enclosing the hills. The recommended area of exclusion is from the consideration of hydrology. The revised POD complies with this recommendation.

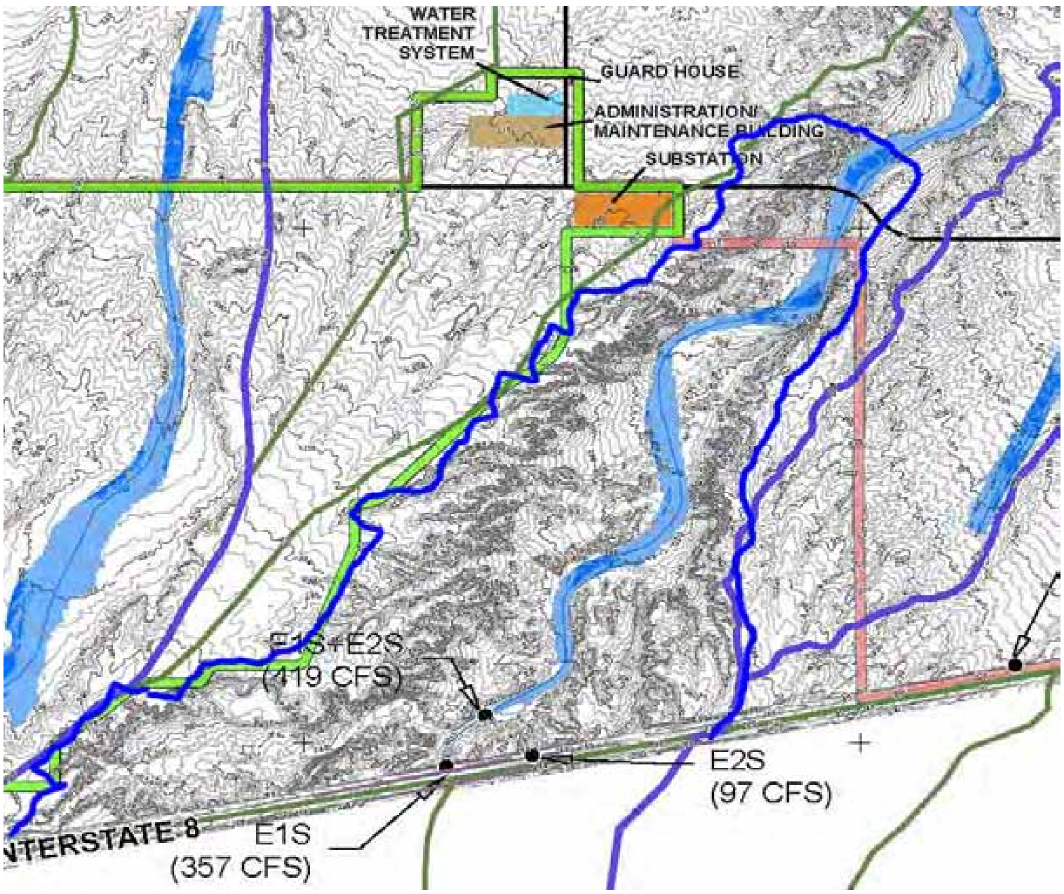

Figure 2. Blue line boundary to exclude inside area for solar units

II. AREAS IN REVISED POD NOT COVERED IN PREVIOUS STUDIES

The revised POD consists of areas for the Solar Two project that are not covered in my previous studies. Such areas are located north of the transmission line and south of Evan Hewes Highway. As shown in Figure 1, these areas are drained by three major washes E, F, and G and several smaller ones. In order to assess the hydrologic impacts on the solar units without any quantitative evaluation, these reaches are compared with their upper reaches south of the transmission line that have been evaluated previously.

Field inspections were made on May 10, 2010 of the washes north the of transmission corridor. Pictures of these washes are shown in Figures 3 for Wash E, in Figure 4 for Wash F, and in Figure 5 for Wash G. These washes are on flat terrains with wide and shallow channels. These lower reaches are generally flatter and wider than the upper reaches south of the transmission corridor.

Storm flows in the desert generally occur as flash floods with the discharge rising and falling rapidly. The flow depths in the washes at the peak 100-yr flood have been determined to be generally less than 1 foot. The velocities at the peak flood discharge vary from low to moderate; they are generally lower than 3 feet per second.

From the sediment modeling study, it was determined that these washes are not subject to substantial changes in channel bed profiles for the existing and proposed conditions. Changes in bed elevation due to general scour are less than 1 foot during the 100-yr flood. Such changes are even less during the 10-yr flood. The solar units are supported on 2-foot cylindrical pedestals. For a pedestal in a wash, the total scour is the general scour plus the local scour at the pedestal base. The maximum local scour that occurs under the worst combination of flow depth and flow velocity has been computed to be 4.2 feet during the 100-yr flood. In view of the stream morphology, the lower wash reaches have slightly lower flow velocities and hence present no significant potential hazard for solar units.

Figure 3. Views of Wash E from the transmission corridor.
The upper picture is a view of Wash E toward upstream.
The lower picture is a view of Wash E toward downstream.

Figure 4. Views of Wash F from the transmission corridor.
The upper picture is a view of Wash F toward upstream.
The lower picture is a view of Wash F toward downstream.

Figure 5. Views of Wash G from the transmission corridor.
The upper picture is a view of Wash G toward south.
The lower picture is a view of Wash G toward downstream.

III. BORDER FENCE DESIGN RECOMMENDATIONS

A fence surrounding the entire project site has been planned. The conceptual design of the fence has not been provided, but it is believed to be tall enough to prevent human passage. It may be a fence with horizontal and vertical steel bars, or a chain link fence. In order to protect the project site, the fence should not allow human passage. The fence will cross certain washes. Depending on the design, the fence may have impacts on surface water flow and sediment transport in the washes.

In order to avoid impacts on the flow and sediment transport, the following features are recommended for fence design:

(1) The steel bar fence is less likely to capture debris carried by the flow, and hence it is considered more desirable than the chain link fence.
(2) At a wash crossing, the bottom of the fence should maintain a clearance of 1 about foot from the stream bed. The 1-foot clearance will pass the 100-yr storm with minimum interference since the flow depth of the 100-yr storm has been determined be about 1 foot.
(3) At a wash crossing, the vertical bars of the fence should maintain a span of at least 8 feet. The vertical bars interfere with the surface water flow. Major interference to flow can be avoided if the spacing between two adjacent bars is at least 8 feet.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
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***APPLICATION FOR CERTIFICATION FOR THE* IMPERIAL VALLEY SOLAR PROJECT**
(formerly known as SES Solar Two Project)
IMPERIAL VALLEY SOLAR, LLC

Docket No. 08-AFC-5
PROOF OF SERVICE
(Revised 6/8/10)

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DECLARATION OF SERVICE

I, Jennifer Draper, declare that on August 9, 2010, I served and filed copies of the attached, Applicant's Re-Submittal of Exhibit 129- U.S. Army Corps of Engineers Draft 404(b)1 Alternatives Analysis for the Imperial Valley Solar Project. The original documents, filed with the Docket Unit, are accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: [http://www.energy.ca.gov/sitingcases/solartwo/index.html]

The documents have been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(*Check all that Apply*)

FOR SERVICE TO ALL OTHER PARTIES:

__X__ sent electronically to all email addresses on the Proof of Service list;

_____ by personal delivery;

__X__ by delivering on this date, for mailing with the United States Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses NOT marked "email preferred."

AND

FOR FILING WITH THE ENERGY COMMISSION:

__X__ sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (*preferred method*);

OR

_____ depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 08-AFC-5
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
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I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

original signed by
Jennifer Draper

*indicates change