APPENDIX 3.1.4-1

Hydrology/Drainage Study

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PRELIMINARY HYDROLOGY AND DRAINAGE STUDY
for the
Jacumba Solar Energy Project
Major Use Permit PDS2014-MUP-14-041
Environmental Review Project Number PDS2014-MPA-14-015
Jacumba, San Diego County, California

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1 DECLARATION OF RESPONSIBLE CHARGE

I, hereby declare that I am the Civil Engineer of work for this report, that I have exercised responsible charge over the preparation of this report as defined in section 6703 of the business and professional code, and that the report is consistent with current project concept.

I understand that the check of the report by the County of San Diego is confined to a review only and does not relieve me, as the Civil Engineer of work, of my responsibilities for the report.

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2 INTRODUCTION

Jacumba Solar, LLC is in the process of developing a solar energy facility, named the Jacumba Solar Energy Project (Proposed Project), in the southeastern part of San Diego County (the County). This Preliminary Hydrology and Drainage Study, referred to as the report, was prepared for the Proposed Project as a part of the Draft Environmental Impact Report (EIR) in accordance with the San Diego County Hydrology Manual (SDCHM).

The purpose of this report is to identify hydrologic impacts as a result of the development of the Proposed Project. This report includes quantification of off-site and on-site runoff discharging onto and from the Proposed Project for pre-development and post-development conditions. Additionally, this report identifies and discusses the mitigation measures proposed for mitigating the increase in runoff. Runoff calculations were performed for the 100-year storm event in accordance with the Rational Method as described in the SDCHM by using the Advanced Engineering Software (AES). Analyses of the existing and proposed 100-year flood inundation levels were conducted using the Army Corps of Engineers' Hydrologic Engineering Centers River Analysis System (HEC-RAS) software.

The hydrologic analysis including watershed delineation, results, and mitigation measures presented in this report are preliminary in nature and subject to change should the boundary, site plan, or other components of the Proposed Project change. Plans, specifications, and recommendations found within this report are not approved and are not for construction purposes; contractors shall refer to the final approved construction documents for construction details.

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3 PROJECT DESCRIPTION

3.1 Project Location

The Proposed Project encompasses a total of approximately 304 acres of which approximately 108 acres would be disturbed for the development of the solar energy facility. The disturbed area for the purposes of this report does not include vegetation management areas outside the fence line. The Proposed Project falls within the Mountain Empire Subregional Plan Area in unincorporated San Diego County and is located approximately 2.5 miles to the east of the community of Jacumba Hot Springs, south of Interstate 8 (I-8), and immediately north of the U.S./Mexico International Border. Figure 1 shows the vicinity map for the Proposed Project.

3.2 Project Description

The Proposed Project encompasses a total of approximately 304 acres within the Mountain Empire Subregional Plan Area in unincorporated San Diego County; however, the solar energy facility comprising the Proposed Project would encompass approximately 108 acres. The solar energy facility would use photovoltaic (PV) fixed-tilt rack electric generation system technology to produce solar energy at the utility scale, producing approximately 20 megawatts (MW).

Implementation of the Proposed Project would include installation of individual fixed-tilt-mounted PV modules, which would comprise the majority of the proposed facilities. PV modules generate electricity by safely converting the energy of the sun's photons into direct current (DC) electrons. The PV module arrays (a row of PV modules) would be a fixed-tilt system that would be oriented along an east–west axis. The PV modules, at their highest point, would be approximately 8 feet above the ground surface. The mounting structures are typically mounted on metal pipe pile or beam foundations 4 to 6 inches in diameter. The beams would be driven into the soil using a pile/vibratory/rotary driving technique.

Depending on final engineering, the arrays may be equal in length, creating a uniform rectangular Project footprint, or may vary in length in order to avoid sensitive resources. The east–west arranged fixed-tilt arrays, if used, would be constructed approximately 25 feet apart (centerline to centerline) in a north–south direction, with an east–west array spacing of approximately 12.5 feet. Each PV module array "row" would measure approximately 144 feet in total combined length and approximately 6.5 feet in width. The PV module arrays' final elevations from ground surface would be determined during detailed Project design; however, it is common to maintain as low an elevation profile as possible to reduce potential wind loads on the PV module arrays. All solar panels at maximum tilt would be raised above the 100-year base flood elevation. The Proposed Project would not place housing within a 100-year flood hazard area.

Following this section of the report, the portion of the Proposed Project that would be disturbed for the development of the solar energy facility (approximately 108 acres) is referred to as the Proposed Project. The hydrologic characteristic would only be impacted within the disturbed area that does not include vegetation management areas outside the fence line.

3.3 Project Hydrologic Characteristics

The Proposed Project falls within the Jacumba Valley hydrologic subarea of the Jacumba hydrologic area located within the Anza Borrego hydrologic unit as identified in Table 1, Project Hydrologic Characteristics. The hydrologic unit, hydrologic area, and hydrologic subarea information was obtained from the Water Quality Control Plan for the Colorado River Basin (Region No. 7), prepared by the California Regional Water Quality Control Board (RWQCB) under the State Water Resources Control Board (RWQCB 2005).

Table 1
Project Hydrologic Characteristics

Hydrologic Unit (HU)	Hydrologic Area (HA)	Hydrologic Subarea (HSA)
Anza Borrego (722.00)	Jacumba (722.70)	Jacumba Valley (722.72)

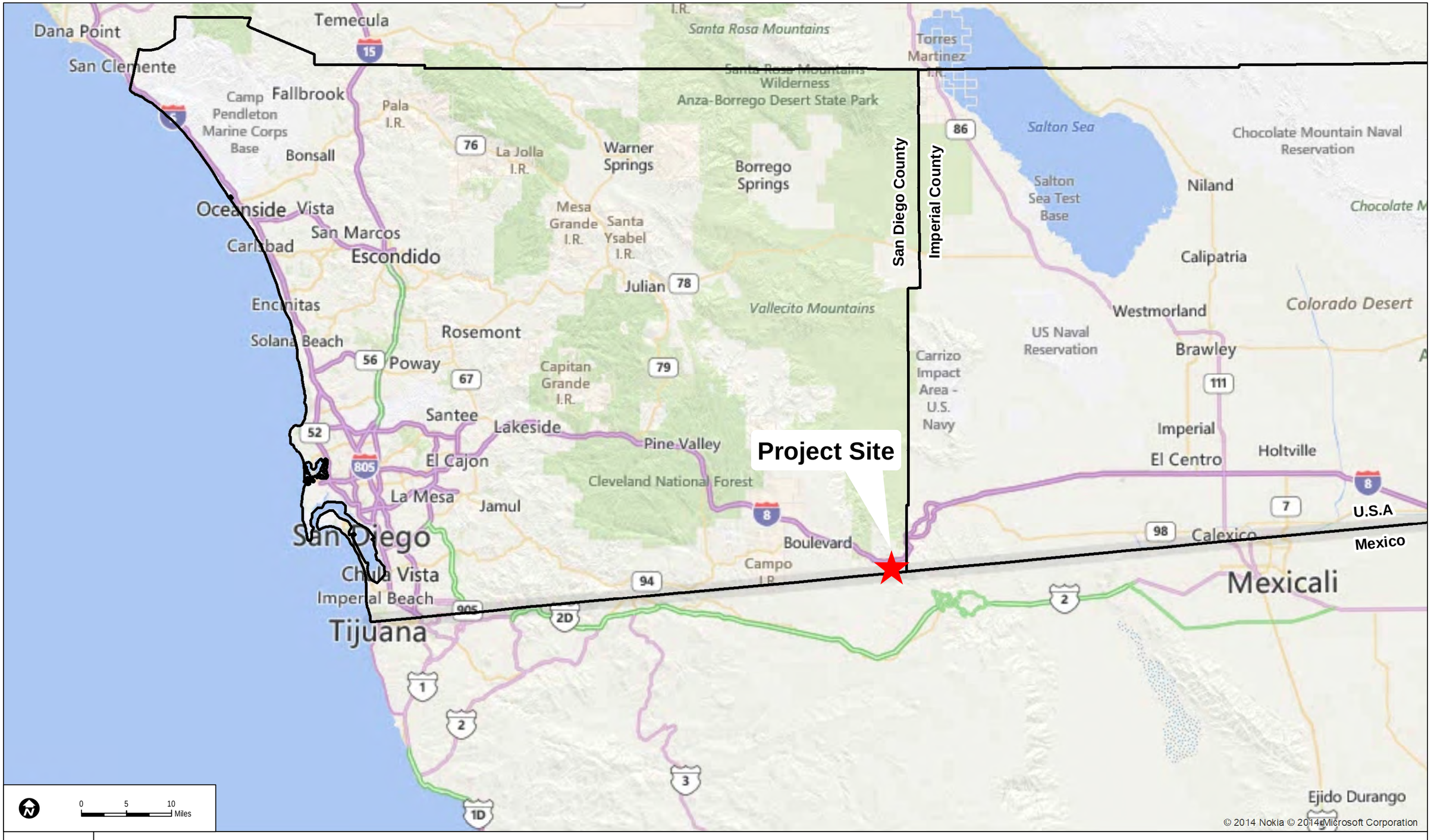
Figure 2 shows the location of the Proposed Project with reference to the Jacumba Valley hydrologic subarea. A comparison of the Proposed Project area with respect to the acreage of the Jacumba Valley hydrologic subarea is presented in Table 2, Project Contribution to Hydrologic Subarea.

Table 2
Project Contribution to Hydrologic Subarea

Hydrologic Subarea (HSA)	Area (Acres)	Approximate Proposed Project Area (Acres)	Estimated Project Contribution (Percent)
Jacumba Valley HSA (722.72)	16,284	108[a]	0.7

[a] The Proposed Project is approximately 304 acres; however, approximately 108 acres of the Proposed Project would be disturbed for the development of the solar energy facility and is considered as the area of the Proposed Project for this report. The disturbed area does not include vegetation management areas outside the fence line.

The Proposed Project area is less than 1% of the area encompassed by the affected Jacumba Valley hydrologic subarea.



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SOURCE: Bing Maps

FIGURE 1

Vicinity Map

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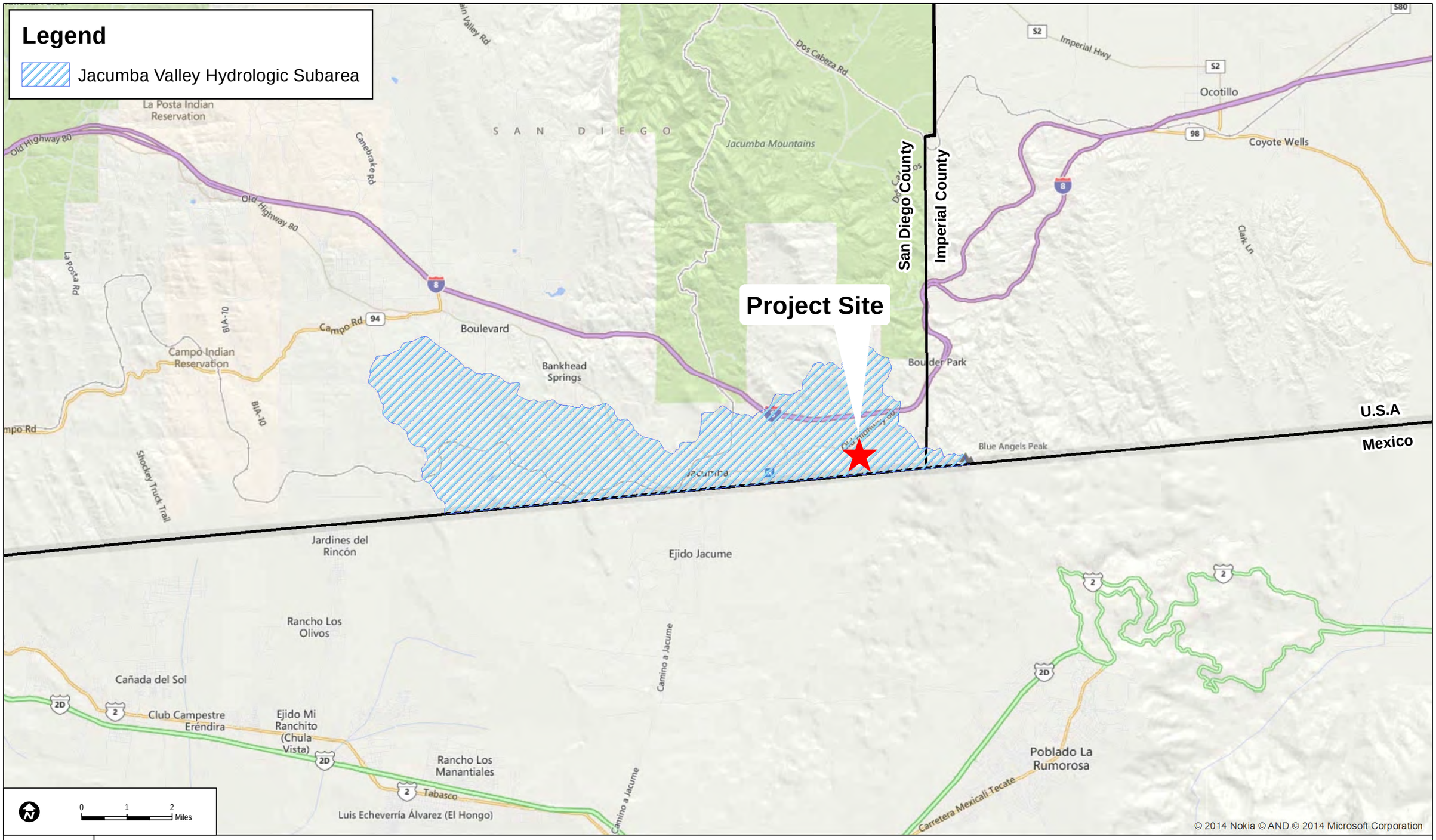

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SOURCE: Bing Maps, SANGIS

FIGURE 2

Hydrologic Subarea

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Jacumba Solar Energy Project - Preliminary Hydrology and Drainage Study

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3.4 Rainfall

The rainfall isopluvial values for the Proposed Project were obtained from the SDCHM. The rainfall isopluvial values for the 100-year 6-hour and 100-year 24-hour storm events are as follows:

100-year 6-hour Rainfall (P_6) = 3.0 inches

100-year 24-hour Rainfall (P_{24}) = 5.0 inches

P_6 / P_{24} = 60%

Per the SDCHM, P_6 for the selected storm event should be between 45% and 65% of P_{24}. This criterion was met as the P_6 for the Proposed Project falls within the specified range. The P_6 and P_{24} isopluvial maps and the Intensity-Duration Design Chart are presented in Appendix C.

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4 EXISTING DRAINAGE (PRE-DEVELOPMENT CONDITION)

4.1 Existing Topography

The Proposed Project is located within the Mountain Empire Subregional Plan Area in unincorporated San Diego County on vacant and undeveloped land that ranges in elevation from approximately 3,096 to 3,168 feet above mean sea level (amsl). An existing topographic map of the Proposed Project for the pre-development condition is shown on Figure 3.

The watershed contributing runoff to the Proposed Project is designated as undisturbed natural terrain based on its topography and terrain, and in accordance with the Natural Resources Conservation Service (NRCS) land use elements described in the Rational Method of the SDCHM that ranges in elevation from approximately 3,096 to 4,325 feet amsl.

4.2 Existing Hydrologic Soil Groups

Soil properties influence the rainfall–runoff relationship due to their varying rate of infiltration. Soils are classified by the NRCS into four hydrologic soil groups based on the soil's runoff potential. The four hydrologic soil groups are A, B, C, and D. Soil Group A generally has the smallest runoff potential and Soil Group D has the highest. A geographic information system (GIS)-based soils analysis was performed to determine the distribution of soil groups within the watershed contributing runoff to the Proposed Project, as shown in tabular format in Table 3, Hydrologic Soil Groups, and in spatial format on Figure 4. The watershed that contributes runoff to the Proposed Project is approximately 555 acres. Soil Group A is the predominant soil group in the contributing watershed, followed by Soil Groups D and B. Approximately 7% of soils in the contributing watershed are undetermined, according to the SDCHM. These undetermined soils were assumed to be Soil Group D due to its highest runoff potential. Additionally, due to the lack of availability of soil group information in the Imperial County and Mexico, these soil groups were assumed based on aerial photography and adjacent soil groups.

Table 3
Hydrologic Soil Groups

Soil Group	Area (Acres)	Area (Percent)
A	228.54	41.16
B	62.85	11.32
C	—	—
D	223.53	40.25
Undetermined	40.37	7.27
Total	**555.30**[a]	**100.00**

[a] Approximately 555 acres is the area of the watershed that contributes runoff to the Proposed Project.

4.3 Existing Land Use

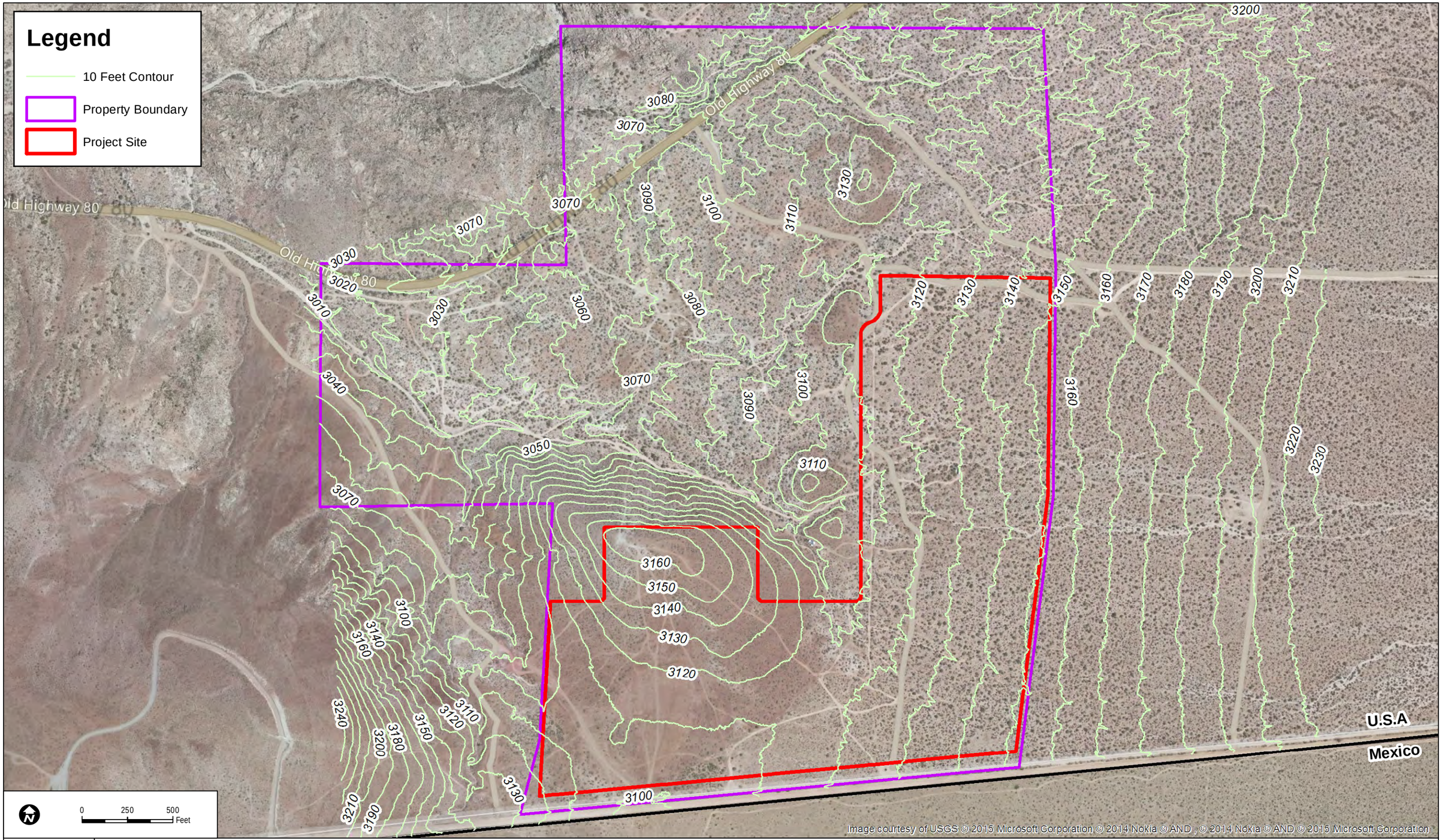
The Proposed Project is in the Mountain Empire Subregional Plan Area on vacant, undeveloped land in unincorporated San Diego County. The Proposed Project and its contributing watershed is generally an arid desert environment that supports a limited range of habitats and biological communities. These habitats and communities include desert scrub and chaparral. Additionally, these habitats and communities may vary depending on the ecoregion, soils and substrate, and topography. Based on the topography and terrain, the Proposed Project as well as its contributing watershed is designated as undisturbed natural terrain in accordance with the NRCS land use elements described in the Rational Method of the SDCHM.

Major land uses surrounding the Proposed Project include the following:

The surrounding Jacumba area, which includes the community of Jacumba Hot Springs, can be characterized as a predominantly rural landscape featuring large-lot ranches and single-family homes with a mixture of small-scale agriculture, recreational opportunities, and vast areas of undeveloped lands. The community also has an old rail line running to the north, with the town characterized by Old Highway 80 as its main street, single-family homes throughout the town, and agricultural uses to the east. Very few single-family homes are scattered amongst the mountainous landscape; however, recent developments have resulted in a variable physical setting that includes both rural and major infrastructure elements, including the East County (ECO) Substation, Kumeyaay Wind Energy Facility, and Sunrise Powerlink.

South of I-8, major infrastructure elements of the landscape include the Sunrise Powerlink, which consists of a 500-kilovolt (kV) electric transmission line supported by 150-foot-tall steel lattice structures and the Southwest Powerlink, which also consists of a 500 kV electric transmission line supported by 150-foot-tall steel lattice structures, as well as several large, vertical, metallic communication towers located at the White Star Communication Facility, and the linear rust-colored U.S./Mexico international border fence located immediately south of the Proposed Project.

In addition, the Golden Acorn Casino and Travel Center is located south of I-8 near the Tecate Divide on reservation lands of the Campo Kumeyaay Nation, and the existing Boulevard Border Protection Station and the adjacent Lux Motel are located south of the interstate near the Ribbonwood Road exit.



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SOURCE: Bing Maps

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FIGURE 3

Existing Topography

Jacumba Solar Energy Project - Preliminary Hydrology and Drainage Study

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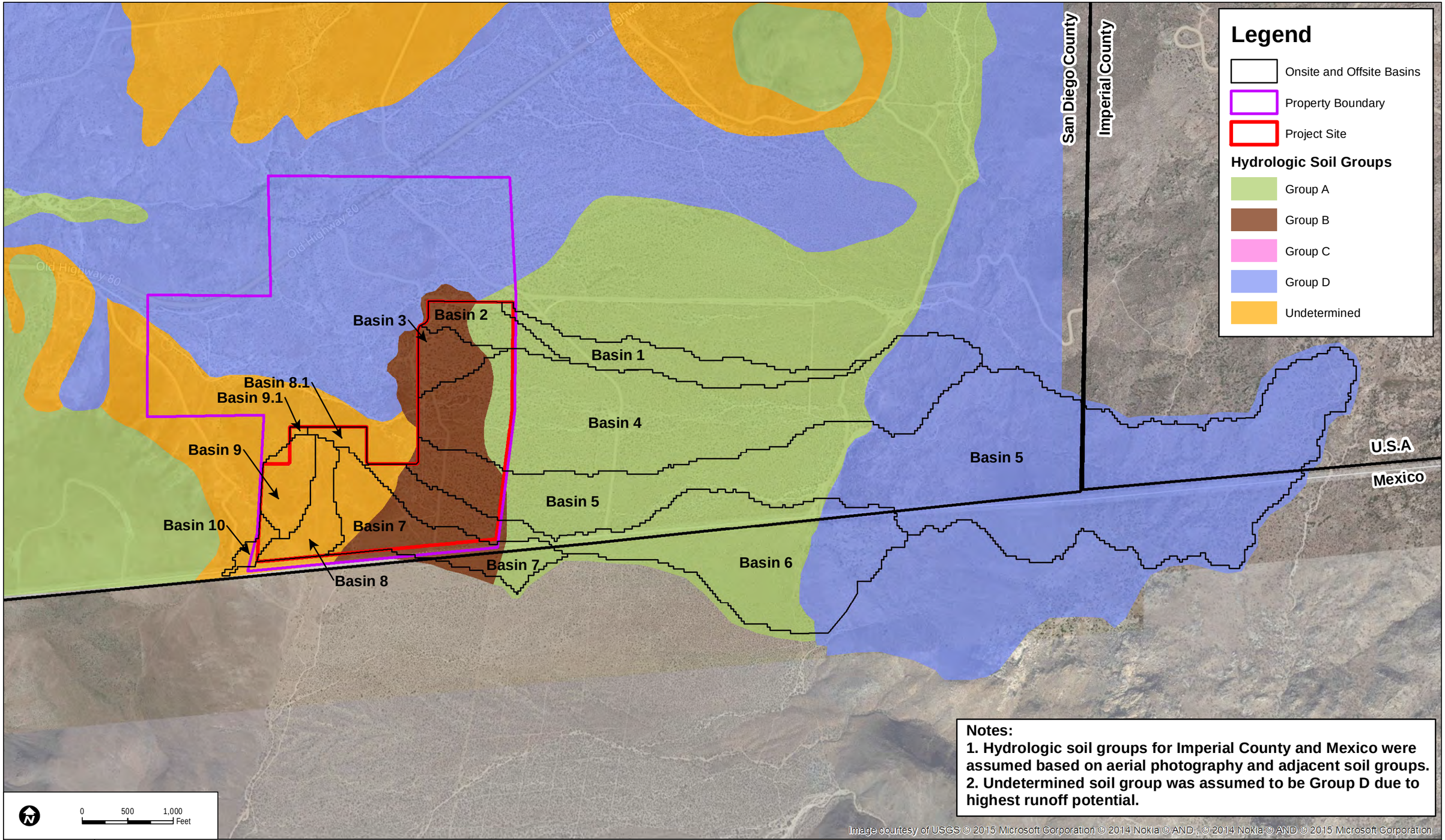

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SOURCE: Bing Maps, SANGIS

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FIGURE 4

Hydrologic Soil Groups

Jacumba Solar Energy Project - Preliminary Hydrology and Drainage Study

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4.4 Existing Runoff

The Proposed Project is located approximately 4,000 feet west of the Sierra Juarez Mountains. Runoff discharging from the Sierra Juarez Mountains generally flows in the westerly direction toward the Proposed Project. A hill located at the western portion of the Proposed Project also flows toward the Proposed Project to the south, west, and east.

For the purpose of quantifying existing runoff discharging onto the Proposed Project for the pre-development condition, the contributing watershed was delineated to determine the extent of the hydrologic unit of land contributing runoff to the Proposed Project. The contributing watershed is approximately 555 acres and was divided into twelve (12) basins, which were further subdivided into smaller sub-basins such that each basin has its own initial subarea followed by subsequent sub-basins. Figure 5 shows the existing drainage for the pre-development condition.

The contributing watershed and its corresponding basins and sub-basins were delineated using the Esri ArcHydro tool in GIS. The ArcHydro tool uses a Digital Elevation Model (DEM) to calculate flow paths between grid cells to generate streams and then subsequently delineates basins and sub-basins within a larger watershed based on the grid cells. The U.S. Geological Survey's National Elevation Dataset with a 1/3 arc second spatial resolution was used as the DEM to delineate the basins and sub-basins within the contributing watershed. Various hydrologic parameters associated with hydrologic modeling, such as area, slope, and length, were also determined as a part of the delineation process.

The existing runoff calculations were performed to quantify peak runoff discharging onto the Proposed Project for the pre-development condition based on the Rational Method as described in the SDCHM by using AES (see Appendix A of this report). AES is a computer-aided watershed modeling program that comes pre-loaded with the County Hydrology Method module. Peak runoff was calculated for all discharge points representing each basin within the contributing watershed for the 100-year storm event. The runoff coefficients (C) used to calculate existing runoff were obtained from the SDCHM (see Appendix C of this report) as shown below:

Soil Type: A; C = 0.20

Soil Type: B; C = 0.25

Soil Type: C; C = 0.30

Soil Type: D; C = 0.35

A GIS-based analysis was performed to calculate weighted C for each basin based on the soil groups (see Appendix A of this report).

The results of the existing runoff calculations for the pre-development condition are presented in Table 4, Existing Results for Pre-Development Condition.

Table 4
Existing Results for Pre-Development Condition

Discharge Point	Existing Results per the San Diego County Hydrology Manual (Rational Method) using AES						
	Basin	*Area (Acres)*	*Weighted C*	*Tc (min)*	*I (in/hr)*	*Peak Q_{100} (cfs)*	*V (fps)*
DP 1	1	21.41	0.20	26.48	2.70	11.55	5.17
DP 2	2	11.08	0.22	17.01	3.59	8.63	3.42
DP 3	3	8.94	0.25	14.71	3.94	8.83	2.89
DP 4	4	123.62	0.23	23.44	2.92	82.60	8.89
DP 5/6	5 and 6	330.83	0.30	29.63	2.51	248.60	10.99
DP 7	7	30.02	0.27	26.23	2.71	22.26	3.22
DP 8	8	11.61	0.35	12.98	4.27	17.37	3.89
DP 8.1	8.1	3.14	0.35	11.39	4.65	5.11	4.69
DP 9	9	11.41	0.35	11.36	4.65	18.57	4.56
DP 9.1	9.1	0.43	0.35	9.92	5.08	0.76	3.41
DP 10	10	2.81	0.35	12.85	4.30	4.23	4.11

Source: Appendix A, AES Modeling Results.
Notes: C = Runoff Coefficient; Tc = Time of Concentration; I = Intensity; Q = Runoff; V = Velocity.
min = minutes; in/hr = inch per hour; cfs = cubic feet per second; fps = feet per second.

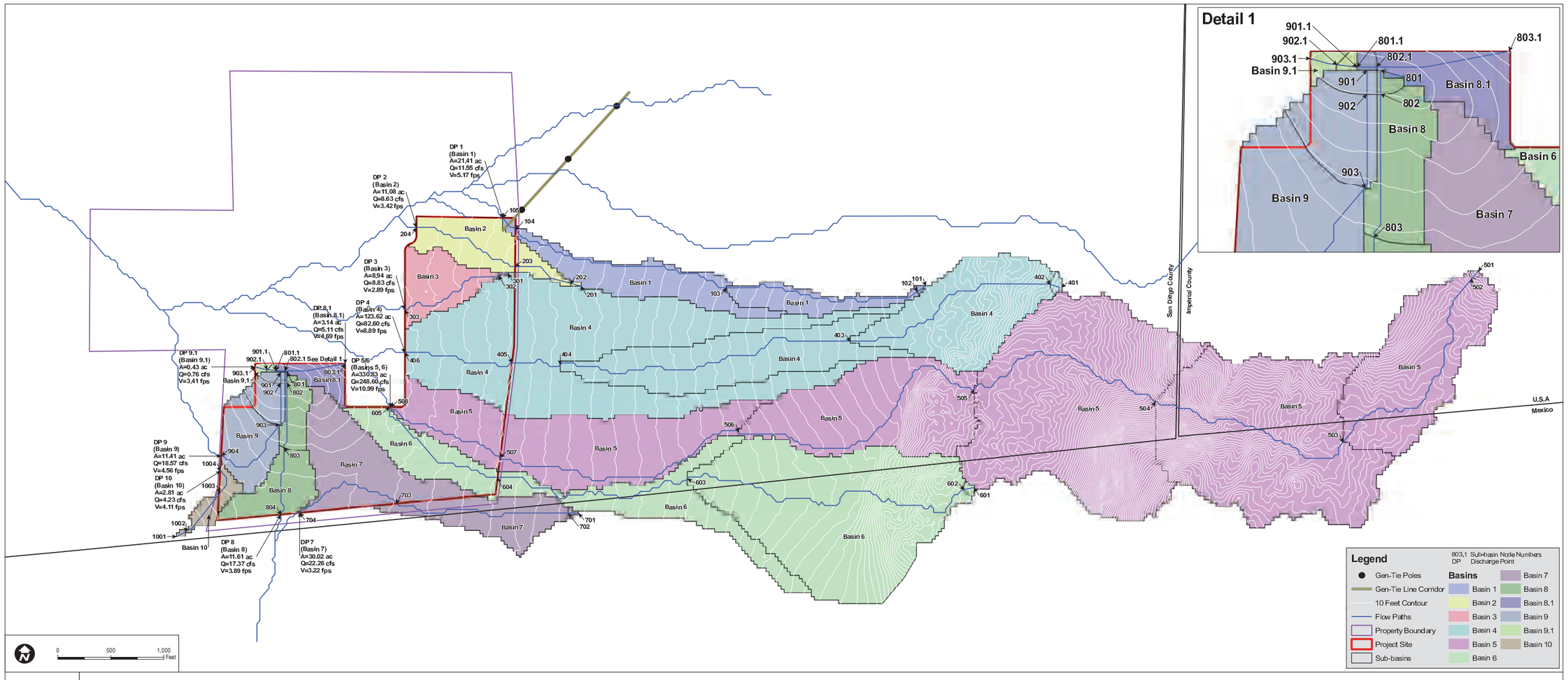

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FIGURE 5

Existing Drainage

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Jacumba Solar Energy Project - Preliminary Hydrology and Drainage Study

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5 PROPOSED DRAINAGE (POST-DEVELOPMENT CONDITION)

5.1 Proposed Topography

Modification to the existing topography is proposed for the post-development condition that would result in on-site topography ranging in elevation from 3,098 to 3,162 feet amsl. A proposed topographic map of the Proposed Project for the post-development condition is shown on Figures 6 and 7. The proposed topography was obtained from the preliminary grading plans prepared by WorleyParsons (see Appendix B of this report).

During the post-development condition, the proposed topography would allow the on-site runoff generated from the Proposed Project to flow generally to the west in the northern portion of the Proposed Project. A hill located at the western portion of the Proposed Project would be graded and flow to the south, west, and east, maintaining drainage patterns similar to the pre-development condition to the maximum extent practical.

5.2 Proposed Hydrologic Soil Groups

The hydrologic soil groups for the post-development condition were assumed to remain the same as the pre-development condition as described in Section 3.2.

5.3 Proposed Land Use

The Proposed Project as well as its contributing watershed is currently vacant and undeveloped, and designated as undisturbed natural terrain in accordance with the NRCS land use elements described in the Rational Method of the SDCHM. The post-development condition would change the existing land use from undisturbed natural terrain to impervious surfaces that would include battery storage area, substation area, and inverter pads. The undisturbed natural terrain includes approximately 555 acres of contributing watershed discharging onto the Proposed Project, of which approximately 1.9 acres (approximately 0.34% of the contributing watershed) would be converted to impervious surfaces comprising battery storage area, substation area, and inverter pads during the post-development condition.

The increase in impervious surfaces due to the development of the Proposed Project would result in a change in imperviousness from approximately 0 acres (0% of the contributing watershed) to approximately 1.9 acres (approximately 0.34% of the contributing watershed). Table 5, Proposed Land Use and Imperviousness for Post-Development Condition, shows the distribution of the proposed land use and percentage of imperviousness after the Proposed Project is developed. The proposed site plan showing the proposed land use for the post-development

condition is shown on Figures 6 and 7. The addition of impervious surfaces is minimal. The Proposed Project would not place housing within a 100-year flood hazard area.

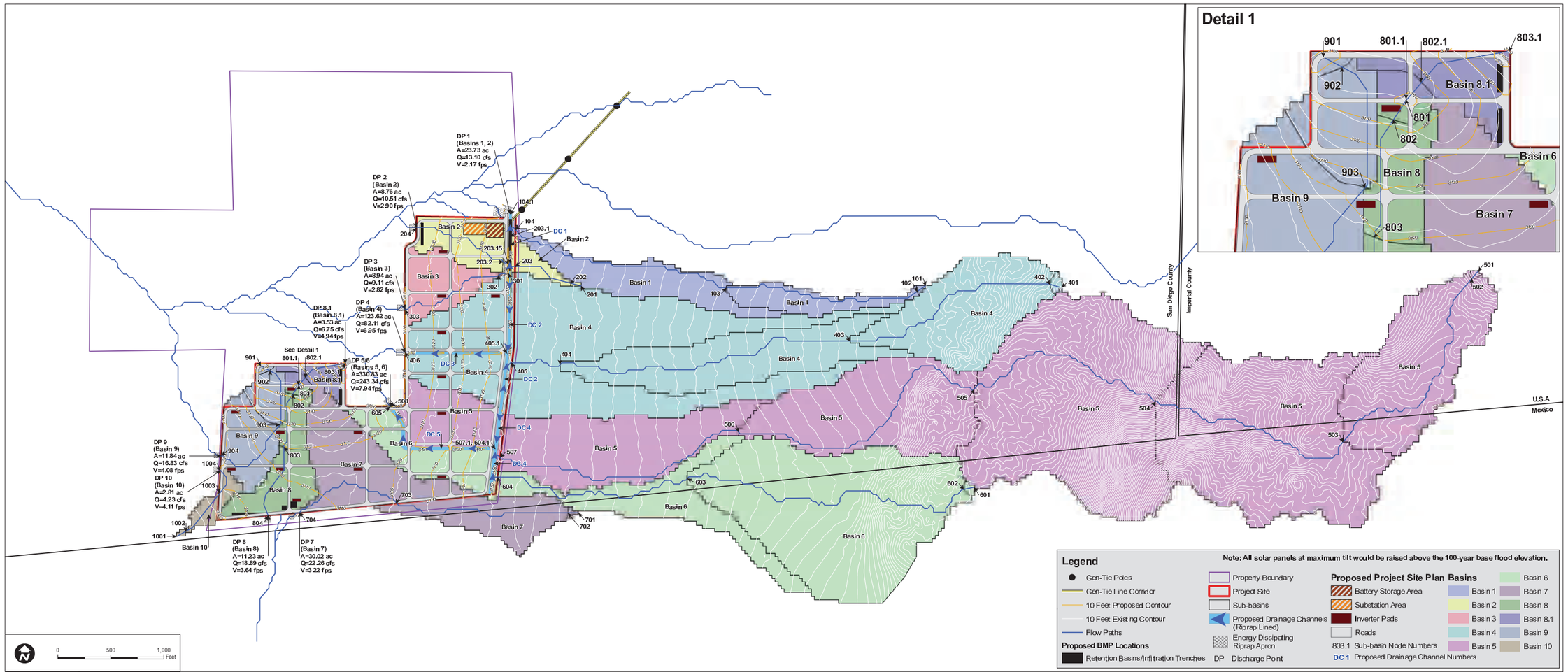
Table 5
Proposed Land Use and Imperviousness for Post-Development Condition

Land Use	Percent Impervious	Proposed Post-Development Condition	
		Area (Acres)	*Area (Percent)*
Natural	0	553.42	99.66
Battery storage area	100	0.50	0.09
Substation area	100	0.54	0.10
Inverter pads	100	0.84	0.15
Total		**555.30**	**100.00**

Additionally, the surroundings of the Proposed Project are experiencing major changes in environmental conditions that are expected to occur before implementation of the Proposed Project. Major projects either approved, in construction, or completed include the San Diego Gas & Electric (SDG&E) ECO Substation project, which includes the rebuilt Boulevard Substation and the 138 kV ECO Transmission Line between the ECO Substation and the rebuilt Boulevard Substation, and the Tule Wind project, which includes 67 wind turbines that would produce up to 186 MW of electricity, a collector substation / operations and maintenance facility on Rough Acres Ranch, and a 3.8-mile-long 138 kV gen-tie (Tule gen-tie) that would connect the on-site collector substation to the rebuilt Boulevard Substation (Department of the Interior 2013).

5.4 Proposed Runoff

Based on the preliminary grading plans prepared by WorleyParsons, proposed runoff would maintain similar drainage patterns as existing runoff to the maximum extent practical. Per the preliminary grading plans, off-site runoff would be collected at the eastern boundary and conveyed across the Proposed Project to the western and northern boundaries via the proposed drainage channels recommended for the post-development condition. Off-site runoff discharging onto the Proposed Project during the post-development condition was anticipated to be similar to the pre-development condition. In other words, for the purpose of this report, no change was anticipated in the off-site runoff discharging onto the Proposed Project for the post-development condition.



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Jacumba Solar Energy Project - Preliminary Hydrology and Drainage Study

FIGURE 6

Proposed Drainage

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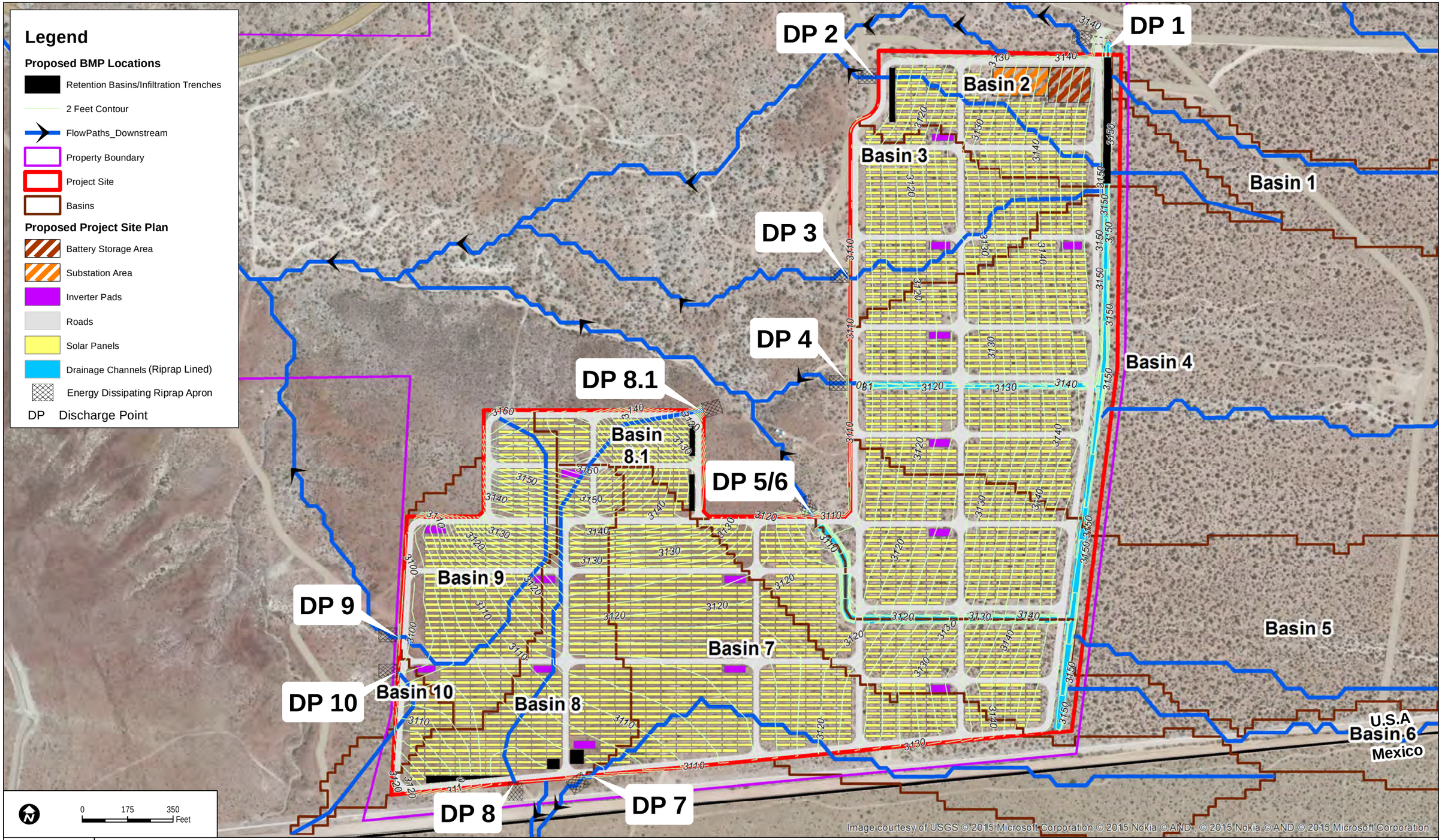

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SOURCE: Bing Maps

FIGURE 7

Proposed Project Site Plan

Jacumba Solar Energy Project - Preliminary Hydrology and Drainage Study

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A brief description of the proposed drainage channels recommended in the preliminary grading plans is as follows:

1. **Proposed Drainage Channel No. 1 –** consists of a drainage channel located along the northeastern boundary of the Proposed Project. This drainage channel would collect the off-site runoff generated from Basins 1 and 2 and would convey it to the north at Drainage Point 1 (DP 1). This drainage channel would also act as a retention basin to mitigate the increase in runoff at DP 1.
2. **Proposed Drainage Channel No. 2 –** consists of a drainage channel located along the eastern boundary of the Proposed Project. This drainage channel would collect the off-site runoff generated from Basin 4 and would convey it toward the Proposed Drainage Channel No. 3 located in the middle of the Proposed Project in the east–west direction.
3. **Proposed Drainage Channel No. 3 –** consists of a drainage channel located in the middle of the Proposed Project in the east–west direction. This drainage channel would collect the off-site runoff discharging from the Proposed Drainage Channel No. 2 located along the eastern boundary and would convey it across the Proposed Project to the western boundary at DP 4 where the off-site runoff would be discharged into Carrizo Creek, which is an existing natural channel.
4. **Proposed Drainage Channel No. 4 –** consists of a drainage channel located along the southeastern boundary of the Proposed Project. This drainage channel would collect the off-site runoff generated from Basins 5 and 6 and would convey it toward the Proposed Drainage Channel No. 5 located in the southern portion of the Proposed Project in the east–west and north–west directions.
5. **Proposed Drainage Channel No. 5 –** consists of a drainage channel located in the southern portion of the Proposed Project in the east–west and north–west directions. This drainage channel would collect the off-site runoff discharging from the Proposed Drainage Channel No. 4 located along the southeastern boundary and would convey it across the Proposed Project to the western boundary at DP 5/6 where the off-site runoff would be discharged into Carrizo Creek, which is an existing natural channel.

Figure 6 shows the proposed drainage for the post-development condition.

For the purpose of quantifying proposed runoff discharging onto the Proposed Project for the post-development condition, the contributing watershed was divided into eleven (11) basins retaining the drainage patterns similar to the pre-development condition to the maximum extent practical, except Basin 9.1 which was merged with Basin 9 based on the preliminary grading plans. For the post-development condition, there is no DP 9.1 because runoff from

Basin 9.1 flows to Basin 9 based on the preliminary grading plans. Therefore, Basin 9.1 was merged with Basin 9.

The proposed runoff calculations were performed to quantify peak runoff discharging onto the Proposed Project for the post-development condition based on the Rational Method as described in the SDCHM by using AES (see Appendix A of this report). Peak runoff was calculated for all discharge points representing each basin within the contributing watershed for the 100-year storm event. The runoff coefficients (C) used to calculate proposed runoff were obtained from the SDCHM (see Appendix C of this report) as shown below:

Soil Type: A; C = 0.20

Soil Type: B; C = 0.25

Soil Type: C; C = 0.30

Soil Type: D; C = 0.35

Impervious Surface; C = 1.0

A GIS-based analysis was performed to calculate weighted C for each basin based on the soil groups (see Appendix A of this report).

The results of the proposed runoff calculations for the post-development condition are presented in Table 6, Proposed Results for Post-Development Condition.

Table 6
Proposed Results for Post-Development Condition

Discharge Point	Proposed Results per the San Diego County Hydrology Manual (Rational Method) using AES						
	Basin	*Area (Acres)*	*Weighted C*	*Tc (min)*	*I (in/hr)*	*Peak Q_{100} (cfs)*	*V (fps)*
DP 1	1 and 2	23.73	0.20	27.60	2.63	13.10	2.17
DP 2	2	8.76	0.32	15.77	3.77	10.51	2.90
DP 3	3	8.94	0.26	14.88	3.91	9.11	2.82
DP 4	4	123.62	0.23	23.87	2.88	82.11	6.95
DP 5/6	5 and 6	330.83	0.30	30.54	2.46	243.34	7.94
DP 7	7	30.02	0.27	26.23	2.71	22.26	3.22
DP 8	8	11.23	0.36	11.44	4.63	18.89	3.64
DP 8.1	8.1	3.53	0.35	8.84	5.47	6.75	4.94
DP 9	9	11.84	0.36	14.47	3.98	16.83	4.08
DP 10	10	2.81	0.35	12.85	4.30	4.23	4.11

Source: Appendix A, AES Modeling Results.
Notes: C = Runoff Coefficient; Tc = Time of Concentration; I = Intensity; Q = Runoff; V = Velocity.
min = minutes; in/hr = inch per hour; cfs = cubic feet per second; fps = feet per second.

6 HYDROLOGIC IMPACTS AND MITIGATION

As a result of the development of the Proposed Project, approximately 1.9 acres (approximately 0.34% of the contributing watershed) of the approximately 555-acre contributing watershed that discharges onto the Proposed Project would be converted from undisturbed natural terrain to impervious surfaces comprising battery storage area, substation area, and inverter pads during the post-development condition.

The increase in impervious surfaces due to the development of the Proposed Project would result in a change in imperviousness from approximately 0 acres (0% of the contributing watershed) to approximately 1.9 acres (approximately 0.34% of the contributing watershed). The addition of impervious surfaces is minimal. Table 7, Comparison of Land Use and Imperviousness for Proposed Project, shows the difference between the distribution of land use and imperviousness for pre-development and post-development conditions.

Table 7
Comparison of Land Use and Imperviousness for Proposed Project

Land Use	Percent Impervious	Existing Pre-Development Condition		Proposed Post-Development Condition	
		Area (Acres)	*Area (Percent)*	*Area (Acres)*	*Area (Percent)*
Natural	0	555.30	100.00	553.42	99.66
Battery storage area	100	—	—	0.50	0.09
Substation area	100	—	—	0.54	0.10
Inverter pads	100	—	—	0.84	0.15
Total		**555.30**	**100.00**	**555.30**	**100.00**

Following is a description of anticipated hydrologic impacts:

- The Proposed Project would maintain the drainage patterns similar to the pre-development condition by mimicking the natural drainage pathways of the contributing watershed to the maximum extent practical. The Proposed Project would not substantially alter the existing drainage pattern of the site, which would result in substantial erosion.
- The Proposed Project would not substantially increase the rate of runoff in a manner, which would result in on-site or off-site flooding. The Proposed Project would not create or contribute runoff, which would exceed the capacity of the proposed drainage system.
- The Proposed Drainage Channel No. 1 would collect the off-site runoff generated from Basins 1 and 2 at the eastern boundary and would convey it to the north at DP 1. The increase in runoff at DP 1 would be minimal and mitigated prior to discharging. All other

proposed drainage channels would collect the off-site runoff generated from Basins 4, 5, and 6 at the eastern boundary and would convey it across the Proposed Project to the western boundary at DP 4 and 5/6. Other than these modifications, the Proposed Project would not place structures within a 100-year flood hazard area which would impede or redirect flood flows.

- During the pre-development condition, existing runoff is likely to produce erosive velocities at DP 4 and 5/6 (approximately 9 and 11 fps, respectively) for the 100-year storm event. However, during the post-development condition, these erosive velocities are likely to reduce at DP 4 and 5/6 (approximately 7 and 8 fps, respectively) based on the AES modeling. The erosion is proposed to be mitigated by the use of fiber rolls, gravel or sand bags, outlet protection, and energy dissipation. These proposed erosion control mitigation measures would provide mitigation for erosion.
- The development of the Proposed Project and changes in the land use and imperviousness would result in a small increase in runoff from the pre-development condition to the post-development condition for DP 1, 2, 8, and 8.1. The anticipated increase in runoff would be minimal and proposed to be mitigated by the use of retention basins/infiltration trenches. The potential locations of the proposed mitigation measures (retention basins/infiltration trenches) shown in this report are conceptual and subject to change depending on the final design.

A comparison of existing and proposed results for the 100-year storm event is presented in Table 8, Results Comparison. The comparison of results is made at same discharge points.

Table 8
Results Comparison

Discharge Point	Existing Pre-development Condition Results							Proposed Post-development Condition Results						
	Basin	*Area (Acres)*	*Weighted C*	*Tc (min)*	*I (in/hr)*	*Peak Q_{100} (cfs)*	*V (fps)*	*Basin*	*Area (Acres)*	*Weighted C*	*Tc (min)*	*I (in/hr)*	*Peak Q_{100} (cfs)*	*V (fps)*
DP 1	1	21.41	0.20	26.48	2.70	11.55	5.17	1 and 2	23.73	0.20	27.60	2.63	13.10	2.17
DP 2	2	11.08	0.22	17.01	3.59	8.63	3.42	2	8.76	0.32	15.77	3.77	10.51	2.90
DP 3	3	8.94	0.25	14.71	3.94	8.83	2.89	3	8.94	0.26	14.88	3.91	9.11	2.82
DP 4	4	123.62	0.23	23.44	2.92	82.60	8.89	4	123.62	0.23	23.87	2.88	82.11	6.95
DP 5/6	5 and 6	330.83	0.30	29.63	2.51	248.60	10.99	5 and 6	330.83	0.30	30.54	2.46	243.34	7.94
DP 7	7	30.02	0.27	26.23	2.71	22.26	3.22	7	30.02	0.27	26.23	2.71	22.26	3.22
DP 8	8	11.61	0.35	12.98	4.27	17.37	3.89	8	11.23	0.36	11.44	4.63	18.89	3.64
DP 8.1	8.1	3.14	0.35	11.39	4.65	5.11	4.69	8.1	3.53	0.35	8.84	5.47	6.75	4.94
DP 9	9	11.41	0.35	11.36	4.65	18.57	4.56	9	11.84	0.36	14.47	3.98	16.83	4.08
DP 9.1[a]	9.1	0.43	0.35	9.92	5.08	0.76	3.41	9.1	Basin 9.1 is a part of Basin 9 for the post-development condition					
DP 10	10	2.81	0.35	12.85	4.30	4.23	4.11	10	2.81	0.35	12.85	4.30	4.23	4.11

Source: Appendix A, AES Modeling Results.
Notes: C = Runoff Coefficient; Tc = Time of Concentration; I = Intensity; Q = Runoff; V = Velocity.
min = minutes; in/hr = inch per hour; cfs = cubic feet per second; fps = feet per second.
[a] For the post-development condition, there is no DP 9.1 because runoff from Basin 9.1 flows to Basin 9 based on the preliminary grading plans. Therefore, Basin 9.1 was merged with Basin 9.

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7 100-YEAR FLOOD INUNDATION

There were no recorded 100-year floodplain limits available within the Proposed Project per the Federal Emergency Management Agency (FEMA) Fire Insurance Rate Maps (FIRMs) or the County's San Diego Geographic Information Source (SanGIS). Analyses of the existing and proposed 100-year flood inundation levels were conducted using the Army Corps of Engineers' Hydrologic Engineering Centers River Analysis System (HEC-RAS) software.

HEC-RAS analysis

Proposed drainage channels 4 and 5 drain more than 100 acres of watershed and convey 83 cfs and 243 cfs, respectively, during a 100-year storm event. Due to the size of the watershed, flow depths and velocity need to be known for design purposes, as well as analysis of the effect of the project on the upstream and downstream properties.

A HEC-RAS hydraulic model was prepared to analyze the existing and post project off-site and on-site drainage flow paths to delineate the 100-yr floodplain limits, and to characterize the drainage path flow hydraulics in order to evaluate the risk level they present to development of the site. The proposed access road crossings are not incorporated in the HEC-RAS model for inundation mapping at this preliminary phase. The access road crossings will be refined and designed per county standards in the design phase.

The Rational method flow rate has been established for the existing and proposed project conditions. The reach boundary conditions that were used in the Jacumba NextEra solar project hydraulic model(s) is critical depth. Each model used critical depth for the upstream reach boundary conditions. There are several stream path junction points in the hydraulic model(s) for the various channel reaches and tributaries. Each of the tributary channel reaches used the actual calculated flow depth at the junction as the downstream reach boundary condition. At the upstream of the tributary channel, critical depth was used as the upstream boundary condition. Each tributary terminates at the stream junction point. The main channel(s) that extend downstream of the tributary junction point(s) used critical depth as the downstream boundary condition. Critical depth is an accurate representation of flow conditions in a natural floodplain or creek. There are many variation in confining boundaries, conveyance cross section, slope, and boundary roughness in natural conveyance systems; therefore most natural systems flow at or near critical depth.

Please refer to Figures 8 and 9 in Appendix E for the pre and post project inundation limits and Tables 9 and 10 below for HEC-RAS summary results. Please refer to Appendix E for the pre project and post project HEC-RAS model runs. The results of the HEC-RAS analyses are provided to aide in a qualitative evaluation of the site development risks. The HEC-RAS model results were used to map the approximate limits of the off-site floodplain in a 100-yr storm event.

Table 9
Existing Condition HEC-RAS Output Data Table for 100-yr Rational Method Discharge

Reach	River Station	Q Total (cfs)	W.S. Elevation (ft)	Velocity Channel (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Channel
4	3200	83	3164.4	4.1	25.7	68.2	1.2
4	3100	83	3158.8	6.0	13.9	28.3	1.5
4	3000	83	3154.3	3.5	23.6	64.5	1.0
4	2900	83	3148.8	5.6	14.7	40.8	1.7
4	2800	83	3144.2	3.7	22.5	52.9	1.0
4	2700	83	3138.4	5.7	14.7	49.6	1.8
4	2600	83	3134.4	3.4	24.2	66.0	1.0
4	2500	83	3129.4	5.8	14.4	32.5	1.5
4	2400	83	3124.7	4.4	18.7	36.0	1.1
4	2300	83	3120.8	5.0	16.5	31.0	1.2
4	2200	83	3117.4	4.5	18.6	31.3	1.0
4	2100	83	3113.0	5.6	14.9	32.5	1.5
4	2000	83	3109.1	3.1	26.7	83.1	1.0
4	1900	83	3105.3	4.5	18.6	37.9	1.1
4	1800	83	3101.1	6.4	13.0	16.2	1.3
4	1700	83	3097.0	6.4	12.9	16.7	1.3
4	1600	83	3092.9	5.8	14.3	21.0	1.2
4	1524	83	3089.1	7.1	11.7	14.8	1.4
5	2025	193	3161.4	4.9	39.1	52.0	1.0
5	1925	193	3156.7	7.4	26.1	44.2	1.7
5	1825	193	3153.0	3.9	50.1	111.9	1.0
5	1725	193	3149.5	6.3	30.8	67.6	1.1
5	1625	193	3144.5	6.9	28.2	57.0	1.7
5	1525	193	3142.0	6.3	30.6	24.6	1.0
5	1425	193	3138.2	6.7	28.9	54.0	1.6
5	1325	193	3133.7	6.7	28.9	27.1	1.1
5	1225	193	3130.2	6.2	31.4	44.6	1.3
5	1125	193	3127.0	4.9	40.2	54.0	1.0
5	1025	193	3122.7	6.3	30.8	55.8	1.5
5	925	193	3119.1	5.5	36.8	47.7	1.0
5	825	193	3115.4	5.5	34.9	72.8	1.4
5	725	193	3112.1	5.6	40.0	109.7	1.0
5	625	193	3109.0	7.4	33.0	43.2	1.3
6	1600	60	3162.3	3.0	19.9	70.2	1.0
6	1500	60	3158.1	3.0	20.2	98.8	1.2
6	1400	60	3154.1	2.6	22.7	103.7	1.0
6	1300	60	3149.7	4.0	15.0	43.6	1.2