FINAL

Groundwater Resources Investigation Report
Tierra del Sol Solar Farm Project
Major Use Permit 3300-12-010; Rezone 3600-12-005
Environmental Review Project Number 3910-120005
Tierra del Sol, San Diego County, California

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NOVEMBER 2013

Printed on 30% post-consumer recycled material.

TABLE OF CONTENTS

Section **Page No.**

GLOSSARY OF TERMS AND ACRONYMS.....GLOSSARY-IV

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION..... 1-1
1.1 Purpose of the Report..... 1-1
1.2 Project Location..... 1-1
1.3 Project Description..... 1-1
1.4 Applicable Groundwater Regulations..... 1-2

2.0 EXISTING CONDITONS..... 2-1
2.1 Topographic Setting..... 2-1
2.2 Climate..... 2-1
2.3 Land Use..... 2-9
2.4 Project Water Demand..... 2-9
2.4.1 Construction Water Demand..... 2-10
2.4.2 Operational Water Demand..... 2-13
2.4.3 Amortize Construction Water Use with Operational Use..... 2-14
2.5 Geology and Soils..... 2-14
2.6 Hydrogeologic Units..... 2-15
2.7 Hydrogeologic Inventory and Groundwater Levels..... 2-16
2.8 Water Quality..... 2-18

3.0 WATER QUANTITY IMPACT ANALYSIS..... 3-1
3.1 50% Reduction of Groundwater in Storage..... 3-1
3.1.1 Guidelines for Determination of Significance..... 3-1
3.1.2 Methodology..... 3-1
3.1.3 Significance of Impacts Prior to Mitigation..... 3-8
3.1.4 Mitigation Measures and Design Considerations..... 3-12
3.1.5 Conclusions..... 3-12
3.2 Well Testing..... 3-12
3.2.1 Guidelines for Determination of Significance..... 3-12
3.2.2 Well B Testing Methodology..... 3-16
3.2.3 Significance of Impacts Prior to Mitigation..... 3-21
3.2.4 Mitigation Measures and Design Considerations..... 3-22
3.2.5 Conclusions..... 3-23

TABLE OF CONTENTS (CONTINUED)

Section **Page No.**

4.0 WATER QUALITY IMPACT ANALYSIS 4-1
4.1 Guidelines for the Determination of Significance 4-1
4.2 Methodology 4-1
4.2.1 Sampling Procedures 4-1
4.2.2 Sampling Analysis 4-2
4.3 Significance of Impacts Prior to Mitigation 4-6
4.4 Mitigation Measures and Design Considerations 4-6
4.5 Conclusions 4-6

5.0 SUMMARY OF PROJECT IMPACTS AND MITIGATION 5-1
5.1 50% Reduction in Groundwater Storage 5-1
5.2 Well Interference 5-2
5.3 Groundwater Dependent Habitat 5-2
5.4 Water Quality 5-3
5.5 Mitigation Measures 5-3

6.0 REFERENCES 6-1

7.0 LIST OF PREPARERS AND PERSONS AND ORGANIZATIONS CONTACTED 7-1

APPENDICES

A Well Test Plan
B Well Logs
C Groundwater Recharge Spreadsheet Calculations
D Well Testing Data
E RWQCB Conditional Waiver No. 2
F Laboratory Analytical Report
G Off-Site Well Monitoring Request Letters

TABLE OF CONTENTS (CONTINUED)

Page No.

FIGURES

1 Regional Location Figures-1
2 Vicinity Map Figures-3
3 Hydrologic Areas Figures-5
4 Regional Mean Annual Precipitation Figures-7
5 Current General Plan Land Use Figures-9
6 Regional Geologic Map Figures-11
7 Soils Map Figures-13
8 IFSAR Digital Elevation Model Figures-15
9 Tierra Del Sol Conceptual Hydrologic Cross Section A-A' Figures-17
10 On-site and Off-site Well Locations Figures-19
11 Potential Groundwater Dependent Vegetation Figures-21
12 On-site Well 1 Water Level Data Figures-23
13 On-site Well 2 Water Level Data Figures-25
14 On-Site Well 3 Water Level Data Figures-27
15 On-site Well 4 Water Level Data Figures-29
16 On-site Well 5 Water Level Data Figures-31
17 On-site Well A Water Level Data Figures-33
18 On-site Well B Pre-Test Water Level Data Figures-35
19 Off-site Well GR-1 Water Level Data Figures-37
20 Off-site Well GS-1 Water Level Data Figures-39
21 Off-site Well GS-2 Water Level Data Figures-41
22 Off-site Well LK-1 Water Level Data Figures-43
23 Off-site Well RM-1 Water Level Data Figures-45
24 Off-site Well RM-3 Water Level Data Figures-47
25 Off-site Well RSD-1 Water Level Data Figures-49
26 Off-site Well RSH-1 Water Level Data Figures-51
27 Off-site Well RSH-2 Water Level Data Figures-53
28 Off-site Well RSH-3 Water Level Data Figures-55
29 Off-site Well WHH-1 Water Level Data Figures-57
30 On-site Well B Step Test Water Level Drawdown Figures-59
31 On-site Well B Constant Rate Test Water Level Drawdown Figures-61
32 On-site Well B Constant Rate Test Log Water Level Drawdown Figures-63
33 On-site Well B Constant Rate Test Jacob Straight Line Analysis Figures-65
34 On-site Well B Constant Rate Test Recovery Analysis Figures-67

TABLE OF CONTENTS (CONTINUED)

Page No.

TABLES

2-1 Climate Temperature Data Recorded at Campo Station, California 2-2
2-2 Rain Gauges in Project Area 2-2
2-3 Precipitation Data Recorded at Boulevard Station 1, California 2-3
2-4 CIMIS Zone 16 Reference Evapotranspiration 2-9
2-5 Construction Water Demand 2-11
2-6 Operational Water Demand 2-13
2-7 Soil Types and Select Soil Properties 2-15
2-8 On-Site and Off-Site Well Description 2-17
3-1 Soil Types and Soil Moisture-Holding Capacities 3-4
3-2 Scenario 1—Existing Conditions 3-5
3-3 Scenario 2—Existing and Proposed Project Conditions 3-6
3-4 Scenario 3—Existing and Proposed Project Conditions with Full General Plan Buildout 3-7
3-5 Groundwater in Storage by Scenario for Wells 6a and 6b 3-8
3-6 Well B Well Users within 0.5 Mile Radius 3-13
3-8 Well B Simplified Lithologic Log 3-17
3-9 Well B Completion Details 3-17
3-10 Well B: Range of Calculated Transmissivity Values 3-19
3-11 Well B Distance Drawdown Calculations 3-20
4-1 Microbiological Water Quality Results 4-2
4-2 General Mineral Water Quality Results 4-2
4-3 Inorganic Minerals Water Quality Results 4-3
4-4 Volatile Organic Compounds (VOCs) Water Quality Results 4-4
4-5 Radiochemistry Water Quality Results 4-5
4-6 Field Water Quality Parameters 4-5

TABLE OF CONTENTS (CONTINUED)

Page No.

EXHIBITS

2-A Annual Precipitation Data Boulevard Stations 1931 to 1994 2-5
2-B Annual Precipitation Data Tierra del Sol Station 1971 to 2011 2-6
2-C Annual Precipitation Data Campo Station 1971 to 2011 2-7
2-D Water Year Precipitation Data 1982 to 2012 2-8
3-A Scenario 1—Existing Demand Groundwater in Storage 3-9
3-B Scenario 2 - Existing and Project Demand Groundwater in Storage 3-10
3-C Scenario 3—Existing, Project and Full General Plan Buildout Demand Groundwater in Storage 3-11

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GLOSSARY OF TERMS AND ACRONYMS

ACOE	Army Corps of Engineers
afy	Acre-Feet per Year
amsl	Above Mean Sea Level
APN	Assessor's Parcel Number
As	Arsenic
B	Boron
bgs	below ground surface
btoc	below top of casing
CDFG	California Department of Fish and Game
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CN	Curve Number
CNM	Curve Number Method
County	County of San Diego
CPV	Concentrator Photovoltaic
CWC	California Water Code
DC	direct current
DG	decomposed granite
DPLU	Department of Planning and Land Use
DWR	Department of Water Resources
ET	Evapotranspiration
EPA	Environmental Protection Agency
GAMA	Groundwater Ambient Monitoring and Assessment
GMMP	Groundwater Mitigation and Monitoring Plan
gpd	gallons per day
gpd/ft	gallons per day/foot
gpm	gallons per minute
HP	Horsepower
HSA	Hydrologic Subarea
IFSAR	Interferometric Synthetic Aperture Radar
K	Thousands
kV	Kilovolt
MCLs	Maximum Contaminant Levels
MG/L	Milligrams per Liter
Mn	Manganese

MUP	Major Use Permit
MW	Megawatt
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resource Conservation Service
NWS	National Weather Service
O&M	Operations and Maintenance
P	Precipitation
PDS	Planning and Development Services
PZN	Precipitation Zone Numbers
Q	Runoff
RL	Rural Lands
RWQCB	Regional Water Quality Control Board
S	Soil Moisture Retention
sf	square foot
SDSU	San Diego State University
SR	Semi-rural Residential
TDS	Total Dissolved Solids
TOC	Top of Casing
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VOCs	Volatile Organic Compounds
V	Vanadium
VR	Village Residential
WSA	Water Supply Assessment

EXECUTIVE SUMMARY

This report describes a groundwater resources investigation for the proposed Tierra del Sol Solar Farm Project (Project), a 420-acre solar energy system to be constructed and operated on privately-owned land in the unincorporated community of Tierra del Sol in southeast San Diego County. Approximately 50 acre-feet of groundwater will be required for initial construction, and an annual average demand of 6 acre-feet per year will be needed for ongoing operations.

An evaluation of existing water supply wells in the Project site area was conducted in January 2012. A drilling program to develop additional project water supply, consisting of the installation of two exploratory wells, was completed in April 2012. One of the exploratory wells (Well B) was enlarged and completed to a depth of 1,311 feet as a production well in July 2012 to supply water for construction and operation of the Project, including water for potable use. Starting in August 2012, a monitoring well network consisting of 6 existing on-site wells and 11 off-site wells was established to determine baseline conditions of groundwater levels and evaluate potential impacts to groundwater levels resulting from the Project. Well B was tested in October 2012 to satisfy requirements of the County Planning Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources (County of San Diego 2007). This report documents the results of Dudek's fieldwork, well monitoring, aquifer testing, and analysis of the groundwater-related impacts related to the proposed Project.

The results of the groundwater resource investigation report are as follows:

- Groundwater is found within alluvium, weathered rock, and in unweathered fractured rock underlying the 0.5-mile radius study area surrounding Well B. There is an estimated 387 acre-feet of water in storage in the study area with an average annual groundwater recharge rate of 27 acre-feet per year (afy) based on an average annual rainfall of 12 inches per year.
- The short-term water demand for Project construction is expected to be 16.1 million gallons, or 50 acre-feet over an approximate 1 year period. Of the total construction water demand, 18 acre-feet (rounded) is requested to be supplied from the on-site supply well (Well B) with up to 32 acre-feet supplied from off-site sources.
- Annual Project operating demand, post-construction, will be 1.8 million gallons or approximately 6 afy (rounded). This is a relatively low demand and corresponds to a long-term average pumping rate of 10.2 gallons per minute (gpm) if the well is operated an average of 8 hours per day and is equivalent to the demand associated with 12 single family residences located on the 420 acre property. All Project operational water demands will be supplied from the on-site supply well (Well B).
- There is sufficient long-term availability of groundwater for the Project based on a water budget analysis, which indicated that the amount of groundwater in storage would not be reduced to a level of 50% or less because of Project pumping.

- No well interference with on-site or off-site monitored wells was observed during a 12-hour step test or a 72-hour constant rate aquifer test. The shallow aquifer system (less than 500 feet below ground surface (bgs) at the Project site) and surrounding area appears to be hydraulically isolated from the deep water bearing fractures intercepted at greater than 1,000 feet bgs by the pumping well (Well B).
- Potential long-term water level drawdown was calculated based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis for a pumping period of 5 years in the absence of rainfall recharge. Pumping volumes were based on 1 year of project construction (18 acre-feet) followed by 4 years of operation (6 afy). Drawdown at the nearest residential wells located 784 feet from the pumping well is projected to be 14 feet. This is less than the County's significance threshold for well interference (typically 20 feet based on a maximum 5% impact to a 400-feet deep well).
- Potential short-term water level drawdown was also calculated based on the Cooper-Jacob approximation for a pumping period of 90 days and 1 year at the nearest residential well, located 784 feet from the pumping well. Drawdown due to both the 90 day peak construction water demand and over the entire 1 year Project construction period, is projected to be 19.9 feet. This is less than the County's significance threshold for well interference (typically 20 feet based on a maximum 5% impact to a 400-feet deep well).
- As projected by the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, drawdown at the nearest groundwater dependent habitat as a result of Project pumping after the approximate 1 year construction period is 18.3 feet. This may exceed the County's significance threshold for groundwater dependent habitat (typically a drop of 3 feet or more from historical low groundwater levels; County of San Diego 2010a).
- Water quality analyses of Well B indicate that all constituents sampled are below U.S. Environmental Protection Agency (EPA) and State of California drinking water maximum contaminant levels (MCLs); therefore, project impacts to due to the use of potable water would be less than significant.
- The transmissivity estimated for Well B is 31.53 $feet^2$/day or 235.84 gallons per day/foot (gpd/ft) using the Theis Recovery equation, which best fit the data with a sum of squares of 12.07.

A separate Groundwater Monitoring and Mitigation Plan (GMMP) has been prepared for the Project (Dudek 2013), which details thresholds for off-site well interference and groundwater dependent habitat. The GMMP provides recommendations for ongoing on-site and off-site water level monitoring and mitigation measures should the monitoring thresholds be exceeded.

1.0 INTRODUCTION

1.1 Purpose of the Report

This report was prepared on behalf of Tierra del Sol LLC by Dudek for submittal to County of San Diego Planning and Development Services (PDS; formerly DPLU) to satisfy groundwater resource investigation scoping requirements outlined in Guidelines for Determining Significance and Report Format and Content Requirements—Groundwater Resources (County of San Diego 2007). This report is also prepared in accordance with the project-specific Well Test Plan approved by the County PDS (Appendix A).

1.2 Project Location

The proposed 420-acre Project site is located in the unincorporated community of Tierra del Sol in southeast San Diego County (Figure 1). The Project site encompasses Assessor's Parcel Numbers (APNs) 658-090-31-00, 658-090-54-00, 658-090-55-00, 658-120-03-00, and 658-120-02-00, consisting of private lands located south of Interstate 8 (I-8). The Project site is bordered on the south by the U.S./Mexico border and is crossed from east to west by Tierra del Sol Road and the 500-kilovolt (kV) Southwest Power Link consisting of steel lattice transmission towers. The study area lies within the Tierra del Sol U.S. Geological Survey (USGS) 7.5-minute quadrangle, Township 18 South, Range 6 East, Sections 13 and 24 (Figure 2).

The Project site is predominantly undeveloped with remnants of small buildings (i.e., foundations and building pads) near the western portion and middle of the site. Several unpaved dirt roads cross the site. The entire Project site is fenced, including the U.S./Mexico border fence along the southern portion of the Project site. The area is accessed through locked gates and dirt roads that traverse the Project site.

1.3 Project Description

The proposed Project would produce up to 60 megawatts (MW) of solar energy and would consist of 2,538 concentrator photovoltaic (CPV) trackers. As proposed, the Project will be developed in two phases. Phase I is a 45 MW CPV electric generation project located on approximately 330 acres. Phase I would include construction of approximately 1,919 CPV trackers. Phase II is a 15 MW CPV electric generation project located on approximately 90 acres. Phase II would include construction of approximately 619 CPV trackers. The Project will be constructed over a period of up to approximately 1 year, which includes both Phase I and II.

The Project includes a Major Use Permit (MUP) to authorize a Major Impact Utility Pursuant to Sections 1350, 2705, and 2926 of the Zoning Ordinance. The project may also require a

Rezone to remove Special Area Designator "A" and ensure compliance with Section 5100 of the Zoning Ordinance.

In addition to the CVP trackers, Tierra del Sol Solar Farm would include the following primary components:

- A 1,000 volt direct current (DC) underground collection system and a 34.5-kilovolt (kV) overhead and underground collection system linking the CPV Systems to the on-site project substation.
- A 4 acre operation and maintenance (O&M) site, including a 7,500-square-foot (sf) (60-foot x 125-foot) O&M building.
- A 3 acre on site private collector substation site would encompass an area of approximately 7,500 sf (75 feet x 100 feet), have a maximum height of 35 feet, and includes 450 sf (15 feet x 30 feet) of metal clad switchgear.
- A 138 kV overhead transmission line (Gen-Tie) would connect the project substation to San Diego Gas and Electric's (SDG&E's) proposed new Boulevard Substation.

Project construction will consist of several activities conducted over a 1 year period including site preparation, development of staging areas and site access roads, solar CPV assembly and installation, and construction of electrical transmission facilities. After site preparation, initial project construction will include the development of the staging and assembly areas, and the grading of site access roads for initial CPV installation.

1.4 Applicable Groundwater Regulations

The San Diego County Groundwater Ordinance Section 67.722.B. states, "The [Major Use Permit] shall not be approved unless the approving authority finds, based upon the Groundwater Investigation or other available information, either: (1) for a water intensive use, the groundwater resources are adequate to meet groundwater demands both of the project and the groundwater basin if the basin were developed to the maximum density and intensity permitted by the General Plan; or (2) for all other projects, that groundwater resources are adequate to meet the groundwater demands of the project (County of San Diego 2013)."

The County Guidelines for Determining Significance—Groundwater Resources contain a series of thresholds for determining significance of water use impacts specific to groundwater quantity and groundwater quality. To evaluate Project impacts to groundwater quantity, a water balance analysis is typically required in combination with pumping tests of existing wells to evaluate potential changes in water levels associated with groundwater use.

This involved conducting supply well testing that consisted of a step-drawdown test followed by a minimum 72-hour constant rate pump test. Data obtained from the well testing were then used to evaluate the long-term availability of groundwater within the basin. The County Guidelines for Determining Significance—Groundwater Resources contains the following guideline that, if met, would be considered a significant impact to local groundwater resources as a result of Project implementation:

> For proposed projects in fractured rock basins, groundwater impacts will be considered significant if a soil moisture balance, or equivalent analysis, conducted using a minimum of 30 years of precipitation data, including drought periods, concludes that at any time groundwater in storage is reduced to a level of 50% or less as a result of groundwater extraction (County of San Diego 2007).

To evaluate off-site well interference as a result of this Project, the following guideline for determining significance is typically used:

> As an initial screening tool, off-site well interference will be considered a significant impact if after a five year projection of drawdown, the results indicate a decrease in water level of 20 feet or more in the off-site wells. If site-specific data indicates water bearing fractures exist which substantiate an interval of more than 400 feet between the static water level in each off-site well and the deepest major water bearing fracture in the well(s), a decrease in saturated thickness of 5% or more in the offsite well would be considered a significant impact (County of San Diego 2007).

To evaluate groundwater quality impacts as a result of this Project, the following guideline for determining significance is typically used:

> Groundwater resources for proposed projects requiring a potable water source must not exceed the Primary State or Federal MCLs for applicable contaminants. Proposed projects that cannot demonstrate compliance with applicable MCLs will be considered to have a significant impact. In general, projects will be required to sample water supply wells for nitrate, bacteria (fecal and total coliform), and radioactive elements. Projects may be required to sample other contaminants of potential concern depending on the geographical location within the County.

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2.0 EXISTING CONDITONS

The following subsections include descriptions of the physical, geologic, and hydrogeologic characteristics of the Project and the Project's watershed. Included are details regarding topography, climate, land use, geology, soils, hydrogeologic units, hydrologic inventory, groundwater levels, groundwater demand, and water quality.

2.1 Topographic Setting

The Project is located just west of the Tecate Divide, which is a series of ridgelines separating drainages that discharge to the Salton Sea from drainages that discharge to the Pacific Ocean. The Project is located in the Hipass Hydrologic Subarea (HSA; 911.85), which is contained in the Campo Hydrologic Area (HA; 911.83) all within the Tijuana Hydrologic Unit (HU; 911.41) that drains toward the Pacific Ocean (Figure 3). The property ranges in elevation from approximately 3,530 feet above mean sea level (amsl) on its southeastern border to about 3,742 feet amsl in the west-central area.

The west–central area is the highest portion of the Project watershed, consisting of a low ridgeline extending from the north–northwest to the south–southeast. Because the Project encompasses a high point in the watershed, there is little to no tributary stormwater run-on to the site. Most areas of the Project site are moderately sloped, between 3% and 5% at the high point, gradually flattening out away from the central ridge and towards the Project boundaries. Localized site areas contain slopes greater than 10%. The existing watercourses are incised around the high point and become shallower and spread out as the runoff flows towards the Project boundaries. The stormwater runoff from the Project flows in almost all directions, except directly north, from the west–central high point. Ten existing watercourses carry runoff from the Project area and outlet across the western, southern, and eastern Project boundaries (AECOM 2012). Ultimately, all of the runoff from the Project site flows south across the International Border.

2.2 Climate

Tierra del Sol experiences warm summer months and cool winters. Average temperatures vary greatly within the region. Mean maximum temperatures in the summer months reach the high-80s to low-90s (degrees Fahrenheit), while dropping into the high-60s (degrees Fahrenheit) in the fall months. Temperatures may fall below freezing in the winter, with snow levels occasionally below 2,500 feet. Table 2-1 displays the average monthly, and annual minimum and maximum temperatures from the Campo station located approximately 8 miles west of the Project at 32°37'

North latitude, 116°28' West longitude, and an elevation of 2,630 feet. Temperature records are not available for the other weather stations discussed below that have precipitation records.

Table 2-1
Climate Temperature Data Recorded at Campo Station, California

Month	Temperatures (°F) 1948 to 2012					Mean Number of Days 1948 to 2012			
	Monthly Averages			Record Extremes		Max. Temp.		Min. Temp.	
	Daily Max.	Daily Min.	Monthly	Record High	Record Low	90°F and Above	32°F and Below	32°F and Below	0°F and Below
Jan.	62.1	33.6	47.9	85	10	0	0	15.2	0
Feb.	63.5	33.8	48.6	86	12	0	0	13.1	0
Mar.	66.2	35.0	50.6	92	15	0.1	0	11.6	0
Apr.	71.3	36.9	54.1	99	20	0.7	0	6.9	0
May	77.8	40.7	59.3	103	25	3.6	0	2.6	0
June	86.6	44.6	65.6	107	29	12.9	0	0.4	0
July	93.8	52.4	73.1	111	34	24.6	0	0	0
Aug.	93.7	53.0	73.3	107	30	24.5	0	0	0
Sep.	89.4	48.9	69.1	107	29	17.0	0	0.2	0
Oct.	79.6	41.9	60.8	103	22	4.9	0	2.4	0
Nov.	69.3	36.3	52.8	92	16	0.1	0	9.8	0
Dec.	62.6	32.7	47.6	86	12	0	0	16.8	0
Year	76.3	40.8	58.6	111	10	88.2	0	78.9	0

Notes: Campo Station is located at 32°37', -116°28' at an elevation of 2,630 feet.
Source: WRCC 2012a.

Precipitation records from five nearby rain gauges were obtained in order to determine annual average rainfall at the Project site. The rain gauges are located in Boulevard (two stations), Tierra del Sol, Morning Star Ranch, and Campo. The location (latitude and longitude), elevation, years of operation, mean annual rainfall and source of data are provided in Table 2-2. Figure 4 also depicts the locations of the rain gauges.

Table 2-2
Rain Gauges in Project Area

Station	Location	Elevation (feet amsl)	Years of Operation	Average Annual Rainfall (inches)	Source
Boulevard 1	N 32°40', W 116°17'	3,353	1924 to 1967	14.8	NOAA
Boulevard 2	N 32°40', W 116°18'	3,600	1969 to 1994	17.0	NOAA
Tierra del Sol	N 32°39', W 116°19'	4,000	1971 to 2012	10.95	County
Morning Star Ranch	N 32°37', W 116°21'	3,659	1990 to 2005	15.8	Ponce
Campo	N 32°37', W 116°28'	2,630	1948 to 2012	14.3	WRCC

Table 2-3 displays average monthly precipitation data and the highest daily precipitation from 1924 to 1967, as collected from the Boulevard Station 1 located approximately 5 miles northeast of the Project at 32°40' North latitude, 116°18' West longitude, and an elevation of 3,250 feet (WRCC 2012b). The majority of the rainfall occurs during the winter months. Average annual precipitation in the Project site area, based on the gauging station at Boulevard Station, is 14.84 inches, with December recording the highest monthly average of 2.58 inches and June recording the lowest monthly average of 0.04 inch.

Table 2-3
Precipitation Data Recorded at Boulevard Station 1, California

Month	Rainfall (inches) – 1924–1967[a]			
	Average	*Highest/Year*	*Lowest/ Year*	*Highest Daily*
Jan.	2.26	7.98/1930	0/1942	2.00
Feb.	2.30	11.58/1927	0/1961	3.76
Mar.	2.13	7.21/1952	0/1959	2.30
Apr.	1.33	4.79/1941	0/1934	1.95
May	0.38	2.64/1957	0/1934	0.93
June	0.04	0.64/1925	0/1928	0.55
July	0.41	2.57/1938	0/1928	1.97
Aug.	1.01	4.96/1936	0/1928	4.00
Sep.	0.66	5.94/1939	0/1928	3.82
Oct.	0.70	3.85/1925	0/1937	3.85
Nov.	1.03	5.74/1965	0/1937	3.30
Dec.	2.58	10.70/1926	0/1958	3.85
Year	14.84[a]	24.50/1936	6.29/1953	4.00

Notes: Boulevard Station 1 located at N 32°40', W 116°18', at an elevation of 3,250 feet from 1924-1967.
Boulevard Station 2 located at N 32°40', W 116°17', at an elevation of 3,359 feet from 1969 to 1994.
[a] Average values for years 1924–1967 including years with missing data.
Source: WRCC 2012b.

According to historical precipitation data recorded from 1924 to 1994 from the combined Boulevard weather stations 1 and 2, the average annual precipitation is approximately 15.0 inches per year (as calculated for years with complete data); with 90% of precipitation occurring between October and April (NOAA 2011). Annual precipitation totals at the Boulevard weather stations vary significantly from year to year as depicted below in Exhibit 2-A.

Using the historical precipitation records from the Tierra del Sol monitoring station located at 32°39' North latitude, 116°19' West longitude, and an elevation of 4,000 feet from 1971 to 2012, average annual precipitation over a 28-year period is approximately 10.6 inches (Exhibit 2-B). A comparison of the available same-water-year precipitation data from Tierra del Sol,

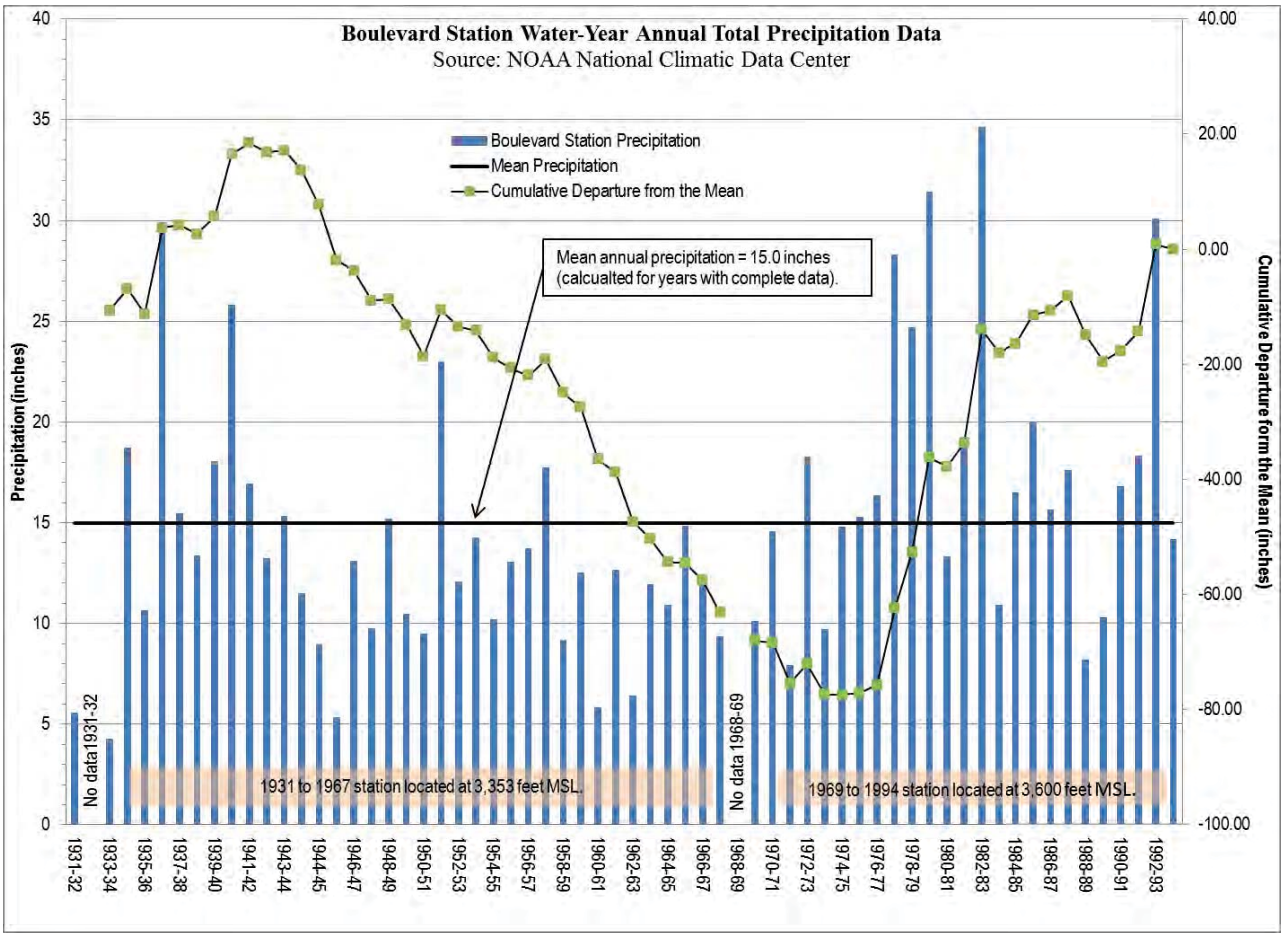
Boulevard, Campo, and Morning Star Ranch indicates that annual precipitation values are typically less at the Tierra del Sol Station (Exhibit 2-C and Exhibit 2-D). Precipitation measured at Campo Station from 1982 to 2011 indicates an average annual precipitation of 15.2 inches, as compared to only 11.3 inches at Tierra del Sol over the same 30-year period (Exhibit 2-C). Precipitation data measured at the Morning Star Ranch from 1990 to 2005 (Ponce 2006), located approximately 1.5 miles northeast of the Project at 32°37' North latitude, 116°21' West longitude and, an elevation 3,659 feet, indicates an average annual precipitation of 15.9 inches as compared to only 12.6 inches at the Tierra del Sol Station over the same 15-year period. The regional mean annual precipitation isohyet for the Project site is reported as 14 inches by the USGS (Figure 4).

The discrepancy in rainfall recorded at Tierra del Sol as compared to the other three rain gauges may be due to (1) variability in rainfall, (2) strength of wind at the gauge affecting how much water collects in the gauge, and (3) differences in the type of rain gauges used. Precipitation in the region can vary during the summer months when convective precipitation (thunderstorms) dominates. This precipitation is highly localized. During the rest of the year, most rain is stratiform (caused by frontal systems) in the local region with some orographic precipitation occurring due to higher elevation of the area relative to the coast. Convective rainfall may explain some, but likely not all, variation in the rainfall record. An additional source of variability in the rainfall record is the local wind strength and gauge placement. The more wind, the less rain caught in the rain gauge due to turbulent flow around the gauge. The rain gauge at Boulevard was located relatively close to the surface of the ground (where the airflow is slower due to friction) in a relatively protected area. In contrast, the rain gauge at Tierra del Sol is located about 8 feet above the ground on a ridgeline subject to fairly high winds during storms. This, difference in the gauge height and local wind strength, could account for a significant portion of the discrepancy between the stations (Allan, pers. comm. 2012). The rain gauge that previously existed at Boulevard and the rain gauge at Campo are standard rain gauges commonly used by the National Weather Service (NWS) for official rain gauge manual observations. The rain gauge at Tierra del Sol is a tipping bucket rain gauge typically used in automated observations. Each type of rain gauge has its own unique rain-catch characteristics. Because of how the rainfall is directed into the tipping bucket, it frequently registers a lower amount of rain relative to the standard rain gauge (Allan, pers. comm. 2012).

Based on review of local rainfall data in the Project area, it appears that the Tierra del Sol rain gauge underestimated rainfall by 20% to 27% during the last 30-year period. Therefore, the water balance analysis presented in Section 3 that uses the Tierra del Sol precipitation data likely underestimates precipitation and groundwater recharge. This conservative analysis is used as the primary analysis for determining whether the project meets the County's significance thresholds.

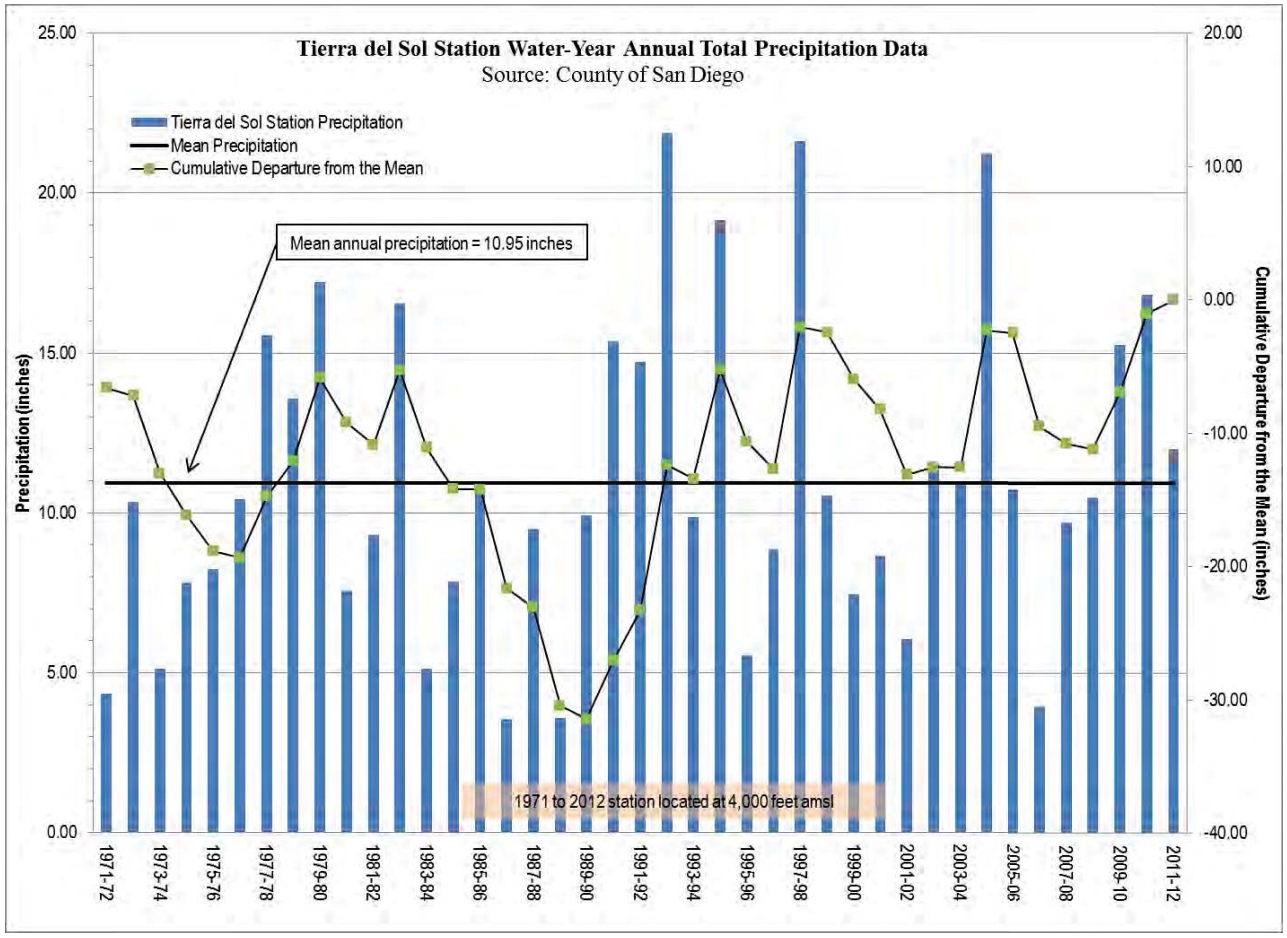
A secondary water balance analysis was also performed using the Campo precipitation data, which is likely more representative of the regional precipitation.

Exhibit 2-A
Annual Precipitation Data Boulevard Stations 1931 to 1994



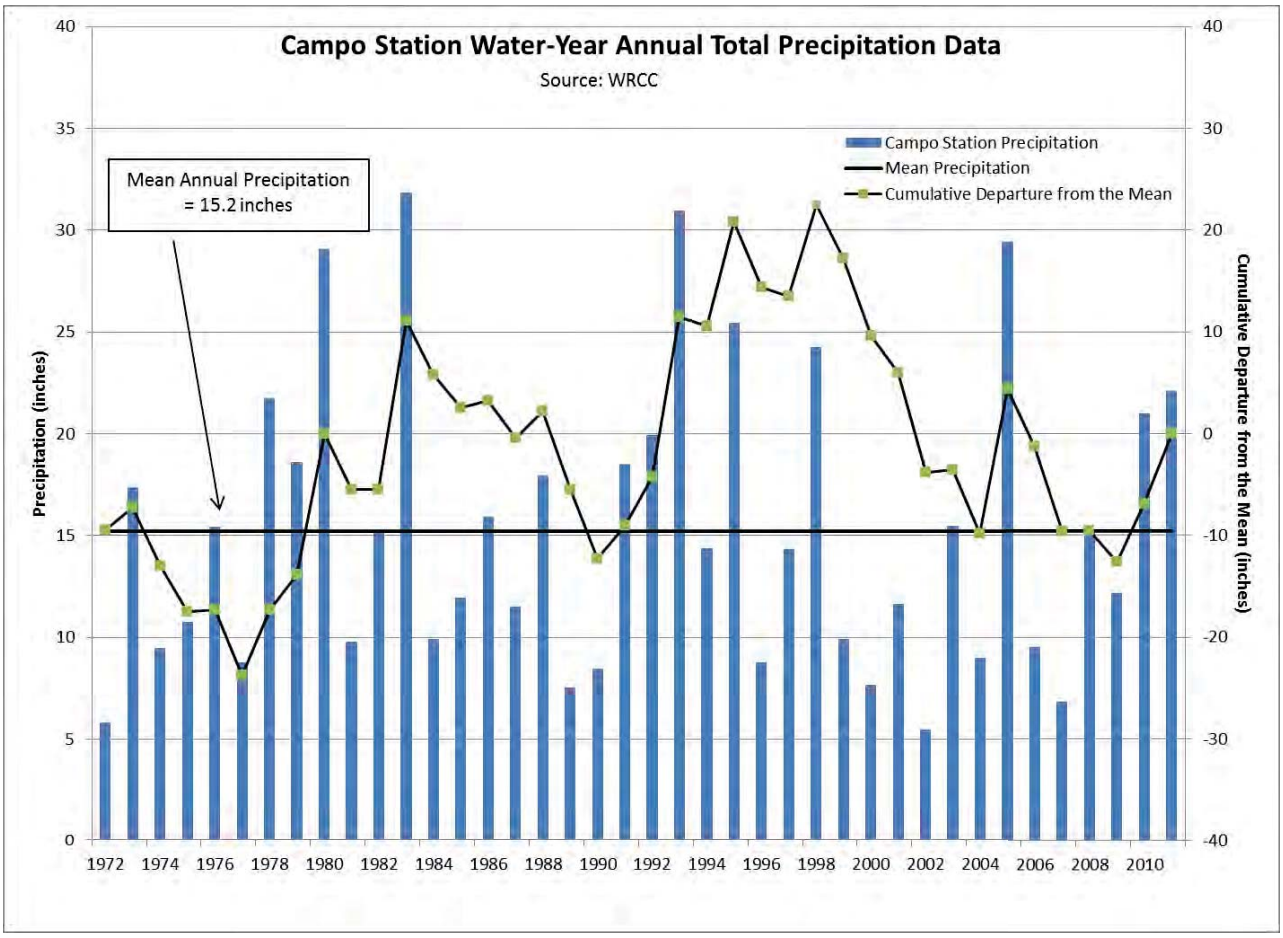
Notes: Boulevard Station 1 located at N 32°40', W 116°17' at an elevation of 3,353 feet from 1924-1967.
Boulevard Station 2 located at N 32°40', W 116°18' at an elevation of 3,600 from 1969 to 1994.

Exhibit 2-B
Annual Precipitation Data Tierra del Sol Station 1971 to 2011



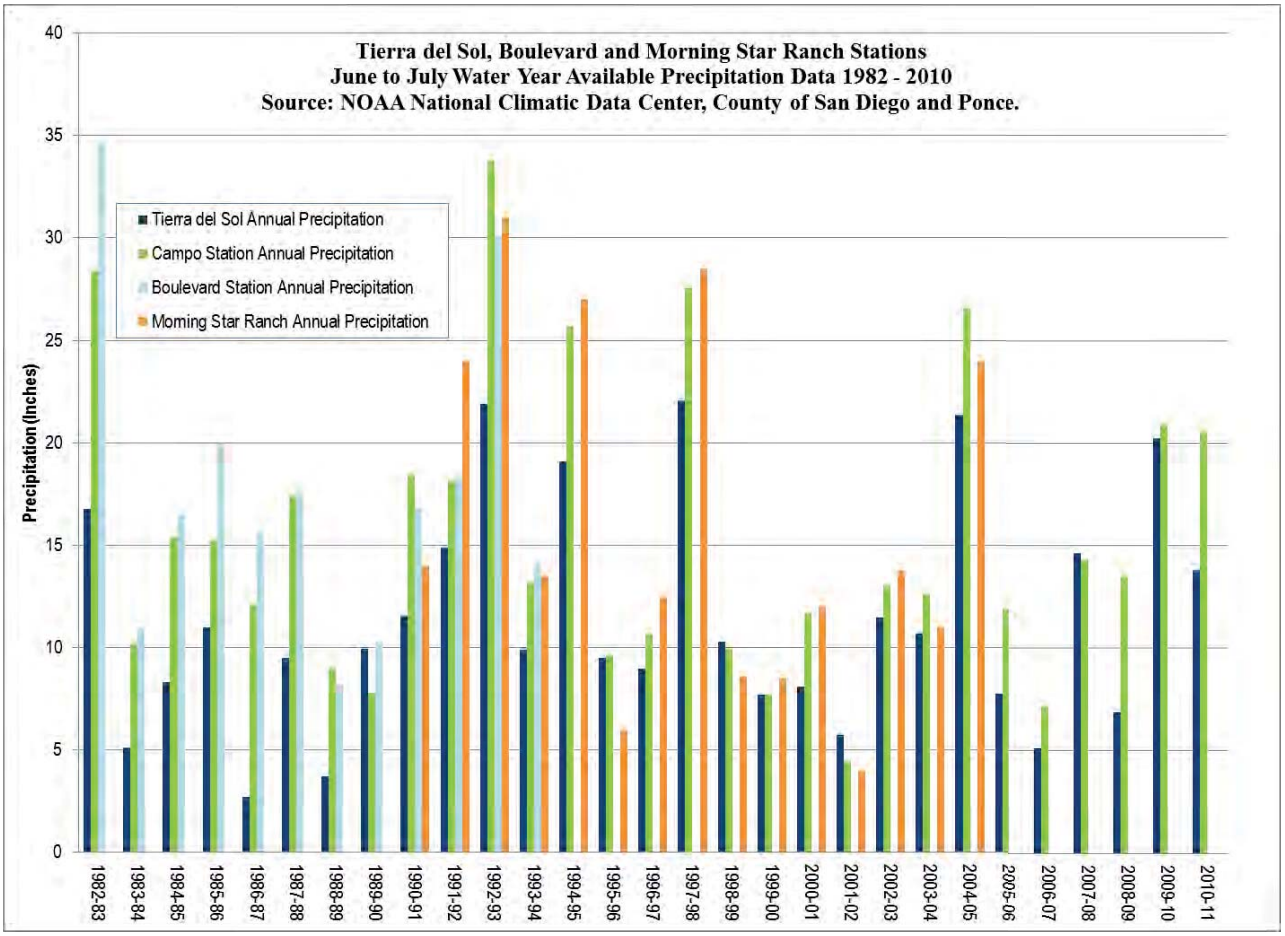
Notes: Station located at N 32°39', W 116°19' at an elevation of 4,000 feet.

Exhibit 2-C
Annual Precipitation Data Campo Station 1971 to 2011



Notes: Station located at N 32°37', W 116°28' at an elevation of 2,630 feet

Exhibit 2-D
Water Year Precipitation Data 1982 to 2012



According to the State of California Reference Evapotranspiration Map developed by the California Irrigation Management Information System (CIMIS), the Project is located in Evapotranspiration Zone 16, with an average of 62.5 inches of reference evapotranspiration (ETo) per year (CIMIS 1999). Table 2-4 presents ETo by month in CIMIS Zone 16. The annual 62.5 inches of ETo is based on potential evapotranspiration (ET) from turf grass/alfalfa crop, which assumes a continuous source of moisture and does not consider summer plant dormancy. Therefore, ETo is an overestimation of actual ET, which varies with the vegetation type since some plants consume significantly more water than others. Drought-tolerant plants and native crops have a crop coefficient of approximately 0.3 (DWR and UCCE 2000), which yields 62.5 x 0.3 = 18.75 inches of estimated ET per year.

Table 2-4
CIMIS Zone 16 Reference Evapotranspiration

Month	ETo (inches)
January	1.55
February	2.52
March	4.03
April	5.7
May	7.75
June	8.7
July	9.3
August	8.37
September	6.3
October	4.34
November	2.4
December	1.55
Year	**62.51**

Source: CIMIS 1999

2.3 Land Use

The Project site is currently undeveloped and surrounded on the west, north, and east by residences that utilize wells for water supply and have leach fields for septic disposal. Inspection of aerial photography taken in 2009 indicates there are approximately 15 residences and associated septic leach fields within 1,000 feet of the Project site. The pre-construction Project surface consists predominantly of scattered brush growing on a thin layer of residual soil, which overlies and is derived from weathered, loose decomposed granitic rock, and granitic rock.

The existing land use to the west, north, and east of the Project is residential. The property to the south of the Project in Mexico is partially developed with residences. The County of San Diego Draft Land Use Update depicts land use surrounding the Project as predominantly rural lands (RL-40 and RL-80; see Figure 5). Additional land use designations in the vicinity of the Project include tribal lands, semi-rural residential (SR-4 and SR-10), and village residential (VR-7.3).

2.4 Project Water Demand

The Project water demand will occur in two distinct phases, with different water requirements for construction versus operation and maintenance.

2.4.1 Construction Water Demand

The water required during construction, soil preparation and grading would be a function of existing vegetation type, soils present on site, the area to be cleared and grubbed on a daily basis, the volume of grading, weather conditions, and project design. The following construction water demands have been calculated with the assumption that water will be conserved as much as is practicable based on technically and economically feasible solutions, such as using a non-toxic tackifier to stabilize site soils, thereby minimizing water use for dust control.

Project construction is expected to last approximately 1 year. The peak construction water demand will occur over a period of approximately 50 working days when the site will be cleared, grubbed and graded. The daily estimated water demand over the 50 day period ranges from 76,000 gallons per day (gpd) to 272,000 gpd (AECOM July 2013). After the site has been cleared and graded, a soil tackifier such as Envirotac II or similar will be applied to the prepared surfaces of the site to stabilize soils. The Envirotac II will last up to 18 months without reapplication. After application of the tackifier, it is anticipated that 18,000 gpd of water will be required, on average, for dust control for areas being actively used (e.g., access roads, equipment and vehicle staging areas, etc.) for the remainder of the Project construction.

The expected water demands by workday are provided in Table 2-5. The total water demand for the Project construction is expected to be 16.1 million gallons, or about 50 acre-feet. Hydraulic testing supports that on-site Well B has a capacity of 61 gpm, or 87,840 gpd (about 7 acre-feet per month). Given the short-term water demand, additional water will be imported to the Project to meet peak construction demand. Over time Well B is assumed to supply on-site groundwater at a rate of up to 7 acre-feet during the first 90 days of construction, decreasing to 0 to 1.8 acre-feet per month for the remainder of the construction period. The total amount of on-site groundwater that would be pumped from Well B over the approximate 1 year construction period is 18 acre-feet.

Table 2-5
Construction Water Demand

Month	Day																													WD	Working Days	Total Demand		Groundwater	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		Total Per Month	K gallons Per Mo.	Acre-feet Per Mo.	On-Site	Off-Site
	Water Demand in Thousands of Gallons (K gallons)																																		
2014																																			
October				272		272	272	272	272	272	272		272	272	272	272	272	272		272	272	272	272	272	272		272	272	272	272	272	68	24	6,599	20.3	2.1	18.2
November	272		272	272	272	272	272	272		272	272	272	272	272	272		272	272	272	76	76	76		76	76	76	76	76	18			68	25	5,049	15.5	2.1	13.4
December	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	22	22	22		22	68	25	552	1.7	1.7	0
2015																																			
January		22	22		22	22	22	22	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18	68	26	560	1.7	1.7	0
February		18	18	18	18	18	18		18	18	18	18	18	22		22	22	22	22	22	22		22	22	22	22	18	18				68	24	544	1.7	1.7	0
March		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	68	26	536	1.6	1.6	0
April	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18												68	17	374	1.1	1.1	0
May																																	0	0	0.0	0.0	0
June																																	0	0	0.0	0.0	0
July																											22	22	22	22	22	68	4	178	0.5	0.5	0
August	22		22	22	22	22	22	22		22	22	22	22	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	68	25	580	1.8	1.8	0
September	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18														68	16	356	1.1	1.1	0
October												22	22	22	22	22	22		22	22	22	22	22	22		22	22	22	18	18	18	68	17	452	1.4	1.4	0
November		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18						68	22	464	1.4	1.4	0
December																																	0	0	0.0	0	0
2014 Total																																203	75	12,199	37.4	5.9	31.5
2015 Total																																608	174	3,933	12.1	12.1	0
PROJECT TOTAL																																**810**	**249**	**16,133**	**50**	**18**	**32**

Activity

- = Clearing, Grubbing, Grinding
- = Mass Grading
- = Concrete Work
- = Daily dust control
- = Non-calendar day
- = Sunday/Holiday

Notes: Water demand estimates include 4,040 gallons per day of water required for concrete work over 63 days, split proportionally (based on no of trackers) across four tracker installation phases. Wind day demand was estimated based on the number of days where average wind speeds exceeded 15 MPH at the Campo Station in the 2012 (22 days) Based on 249 construction days out of 365 day calendar year this works out to 15 wind days. The associated water requirement was split evenly across the months during which construction would occur. WD = Wind Day Demand (Additional dust abatement required when winds exceed 15 MPH).

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2.4.2 Operational Water Demand

The highest operational water demands are anticipated to occur during CPV panel washing and application of a non-toxic soil binder to stabilize site soils. Panel washing, which would occur approximately nine times per year by mobile crews, will be undertaken using a tanker truck and smaller "satellite" panel washing trucks. On-site water storage tanks will be installed to facilitate washing and to support fire suppression. Each panel washing truck will carry water treatment equipment and truck-mounted panel washing booms. Water will be treated to ensure a hardness level of 7 milligrams per liter (mg/L) or less and to remove impurities. Wastewater from water conditioning not used for panel washing will be captured and disposed of off site. As a conservative estimate, approximately 24 gallons of water will be required to wash each set of tracker modules for a total of 548,208 gallons per year, or 1.68 afy.

It is anticipated that the soil stabilizer chosen for the Project would need to be reapplied annually. The Project would utilize a soil binding stabilization agent that is nontoxic and permeable. The purpose of the soil stabilizer is to prevent erosion and to reduce fugitive dust. Reapplication of the soil stabilizer agent requires approximately 3,300 gallons of water per acre. Approximately 183 acres, consisting of O&M building areas, substation, fire and service roads, will be surfaced with decomposed granite requiring annual soil stabilizer application. Thus, the annual water demand for soil binder application is anticipated to be approximately 603,900 gallons, or 1.9 acre-feet. Sanitary and drinking water needs associated with the operation and maintenance building would require approximately 125,664 gallons per year or 0.38 afy based on an average monthly water usage of 10,472 gallons. The proposed landscape vegetative screen would require 508,328 gallons per year or 1.56 afy.

To meet operational water demand, the Project is expected to require approximately 1.8 million gallons or approximately 6 afy (rounded) as shown in Table 2-6.

Table 2-6
Operational Water Demand

Application of Soil Binder (if required)	
Number of gallons/acre/year[1]	3,300
Acres[2]	183
Water use/year – gallons (acre-feet)	603,900 (1.85)[3]
Tracker Washing	
Washes/year	9
Number of trackers	2,538
Gallons/tracker/wash (maximum)	24
Water use/year – gallons (acre-feet)	548,208 (1.68)[3]

Table 2-6
Operational Water Demand

Potable Water Needs	
Water use/year[4] – gallons (acre-feet)	125,664 (0.38)[3]
Landscape Vegetative Screen	
Water use/year – gallons (acre-feet)	508,328 (1.56)[3]
Total Water Use Per Year	**1,786,100 gallons/ ~6 acre-feet (rounded)**

1 Based on application of nontoxic permeable soil binding agent 3,300 gallons per acre annually.
2 Based on the acreage surfaced with decomposed granite within the project site, consisting of O&M building areas, substation, fire and service roads.
3 One acre-foot = 325,851 gallons
4 Average monthly water usage is 10,472 gallons per household according to the City of San Diego (2012).

2.4.3 Amortize Construction Water Use with Operational Use

In order to determine whether the Project is required to complete a Water Supply Assessment (WSA) in accordance with California Water Code (CWC) Section 10912(a)(5)(B), the Project construction water use is amortized over a 20-year period, which is the period that WSAs are required to review. No WSA is required unless the facility qualifies as a "project." CWC Sec. 10912(a)(5)(B) defines what a "project" is for solar and wind projects. It states that a "proposed photovoltaic or wind energy generation facility approved on or after the effective date of the amendments made to this section at the 2011–12 Regular Session is not a project if the facility would demand no more than 75 acre-feet of water annually." The water demand for the 1 year construction period is 50 acre-feet, and the annual water demand for operation is approximately 6 afy. Therefore, over a 20-year period the Project will use 164 acre-feet or 8.2 afy amortized over 20 years. As the Project will demand less than 75 acre-feet of water annually amortized over the 20-year period, a WSA is not required.

2.5 Geology and Soils

The Project site is located on the eastern portion of the Peninsular Range geomorphic province which is a series of northwest-oriented mountain ranges extending from the Transverse Ranges near Los Angeles south through the Baja California peninsula. The Project site geology consists of a thin cover of residual soil and weathered granitic rock overlying granitic bedrock, designated as Cretaceous age La Posta Tonalite (see Figure 6; USGS 2004).

Based on maps prepared by the U.S. Department of Agriculture (USDA) Soil Conservation Service, the Project site is predominantly underlain by the Kitchen Creek loamy coarse sand (soil unit KcC in Figure 7). The northwestern and northeastern edges of the site are underlain by the La Posta rocky loamy coarse sand (soil unit LcE2) and the Mottsville loamy coarse sand (soil

unit MvC), respectively. Due to the granitic parent rock, the on-site soils are sandy, relatively shallow, and have a greater susceptibility to wind erosion than water erosion. Soil types and their properties within the Project area are presented in Table 2-7.

Table 2-7
Soil Types and Select Soil Properties

Soil Type	Soil Unit	Soil Moisture Holding Capacity (inches)	Runoff	Hydrologic Soil Group	Area (acres) within Project Site	Area (acres) within 0.5-miles of Well B
Kitchen Creek loamy coarse sand	KcC	3-5.5	Slow-Medium	B	400	193.7
La Posta rocky loamy coarse sand	LcE2	1-2	Medium	A	3.8	118.9
Mottsville loamy coarse sand	MvC	4-5	Slow-Medium	A	20.7	143.6
				Total	**424.5**	**456.2**

Source: Moisture Holding Capacity, Runoff, and Hydrologic Soil Group values obtained from USDA 1973.

2.6 Hydrogeologic Units

Boring logs were obtained for several of the existing on-site wells and for wells in the vicinity of the Project site. Two exploration wells were drilled for the Project to further characterize the subsurface lithology. Additionally, all existing on-site wells were video logged to determine well condition, and lithology in uncased wells. The subsurface lithology encountered at the Project site and within the 0.5-mile radius of the pumping well (Well B) consists of the following:

Alluvium: The soils map (Figure 7) identifies the parent material for the Mottsville loamy coarse sand as alluvium derived from granitic rocks. While alluvium was not encountered in the Project wells, alluvium does occur within 0.5 mile of Well B primarily associated with Rattlesnake Creek that runs in a northwest to southeast direction immediately east of the Project site. The area mapped as Mottsville loamy coarse sand within a 0.5-mile radius of Well B is 143.6 acres (or 31% of the area), as listed in Table 2-7. The depth of alluvium within the Project site is unknown, but presumed to be thin, based on well logs within the Project boundaries. Outside the Project site, alluvium may be up to 100 feet thick close to Rattlesnake Creek at Well RM-3. Well RM-3 is a shallow well with a higher production rate than wells in the surrounding area outside of the extent of the mapped surficial alluvium. The exact depth of alluvium is unknown as no well log is available for RM-3.

Decomposed Granite (DG): Weathered bedrock consisting of decomposed granite (DG) was noted in site well logs and video logs, encountered in the two exploration water wells, and geotechnical borings drilled on the Project site (Ninyo and Moore 2012).

Granitic Bedrock: The crystalline bedrock is predominantly composed of tonalite. It is extensively fractured as evidenced by regional lineaments that trend both northwest–southeast and west–east as depicted on the interferometric synthetic aperture radar (IFSAR) digital ortho-photography (Figure 8). Extensive fractures were also logged up to a depth of 1,311 feet while drilling on-site Wells A and B (Appendix B).

A cross section has been produced for the Project site using reported lithology from on-site Wells 1, 2, 3, 5, A and B as depicted in Figure 9. Based on a depth to groundwater of 50 to 80 feet bgs and approximately 100 feet of DG underlying the Project site, there is likely 20 to 50 feet of saturated DG. Because water-producing fractures were encountered during drilling of Well B to its total depth of 1,311 feet bgs, the saturated thickness of fractured granitic rock is in excess of 1,000 feet. The water balance analysis discussed in Section 3.0 uses an assumed saturated thickness of DG and fractured granitic rock of 5 feet and 500 feet, respectively. Therefore, the water balance is conservative in regards to available groundwater storage.

2.7 Hydrogeologic Inventory and Groundwater Levels

Five existing water wells (Wells 1-5) and one hand-dug well were identified on the Project site and are associated with previous ranching and agricultural activities that occurred on the site (Dudek 2012a). Two additional exploratory water wells (Wells A and B) were drilled to depths of 1,000 feet and 1,310 feet, respectively, to characterize site lithology and determine suitability for groundwater production. Well yields for on-site wells range from 2 to 61 gpm with an average well yield of approximately 12 gpm. On-site wells are predominantly completed in DG and fractured granitic bedrock as discussed in Section 2.6.

Access to 13 off-site wells was provided by property owners to install sounding tubes for measuring water levels. The location of on-site and off-site wells is depicted in Figure 10, and well information including groundwater levels is provided below in Table 2-8. In addition, 17 unique, confidential well logs were reviewed to determine well depth, production and lithology (residuum/bedrock contact). Depths for off-site wells range from 20 to 1,000 feet. Well yields for off-site wells range from 1 to 100 gpm with an average of 19 gpm. Off-site wells are completed in alluvium, DG and fractured granitic bedrock. The DG/bedrock contact is reported to range from 5 to 420 feet deep with an average depth of 69 feet bgs.

Table 2-8
On-Site and Off-Site Well Description

Well Number	Total Depth (feet bgs)	Depth to Water (feet bgs)/date	Production Capability (gpm)	Alluvium (feet bgs)	Decomposed Granite (DG) (feet bgs)	Fractured Granite (feet bgs)
On-site Wells						
Well A	1,000	42.43 (8/22/12)	1.8[e]	—	0–100	100–1,000
Well B	1,311	48.66 (8/22/12)	61	—	0–100	100–1,311
Well 1	282	48.85 (6/25/12)	2	—	0–100	100–282
Well 2[a]	491.7	93.0 (6/25/12)	5	—	0–100	100–491.7
Well 3	911.8	79.51 (6/25/12)	3	0-8	8-18	18–911.8
Well 4[b]	25	8.83 (6/25/12)	10	—	0–25	up to 150
Well 5[c]	90	41.6 (10/17/12)	8	—	0–90	—
Hand-dug Well[d]	25.6 (collapsed)	Dry to 25.6	3	—	0–20	up to 100
Off-site Wells						
CW-1	400	Obstructed	30	0–20 (est.)	20–100 (est.)	100–400 (est.)
GR-1	459	67.0 (9/21/12)	20	0-15	15-35	35-460
GS-1	138	39.7 (10/4/12)	NA	0–10 (est.)	10–100 (est.)	100–138 (est.)
GS-2	366	41.7 (10/4/12)	65	0–10 (est.)	10–100 (est.)	100–366 (est.)
LK-1	375	32.60 (9/13/12)	15	0–10 (est.)	15–100 (est.)	100–375 (est.)
RM-1	147	21.61 (9/7/12)	NA	0–50 (est.)	50–100 (est.)	100–147 (est.)
RM-2	200	Obstructed	NA	0–50 (est.)	50–100 (est.)	100–200 (est.)
RM-3	155	21.83 (8/25/12)	65	0–100 (est.)	100–155 (est.)	—
RSD-1	299	34.95 (8/18/12)	15	0-36	36-120	120-300
RSH-1	260	14.32 (8/25/12)	100	0-35	—	35-280
RSH-2	19.9	6.70 (8/25/12)	NA	0–19.9 (est.)	—	—
RSH-3	300	17.00 (9/19/12)	25	0-38	NA	38-300
WHH-1	254	51.1 (10/2/12)	NA	—	0-18	18-260
Off-site Confidential Well Log Summary[f]						
645	177	NA (8/9/94)	18[e]	0-36	—	36-180
3131	220	30 (11/26/89)	18[e]	—	0-48	48-220
4133	620	NA (12/13/95)	3[e]	—	0-10	10-620
4632	150	15 (12/4/84)	20[e]	0-18	18-60	60-180
5337	500	NA (3/30/96)	5[e]	—	0-5	5-500
8418	375	30 (9/4/87)	5.5[e]	—	0-30	30-375
8681	230	40.0 (4/16/86)	9[e]	—	0-90	90-230
9056	245	30.0 (4/26/86)	7[e]	—	0-62	62-245
10598	340	94 (5/11/76)	1.27[e]	—	0-70	70-340
10956	650	250 (7/30/82)	1.0[e]	—	0-12	12-650
12025	110	55 (11/10/80)	20[e]	—	0-55	55-110

Table 2-8
On-Site and Off-Site Well Description

Well Number	Total Depth (feet bgs)	Depth to Water (feet bgs)/date	Production Capability (gpm)	Alluvium (feet bgs)	Decomposed Granite (DG) (feet bgs)	Fractured Granite (feet bgs)
15149	500	NA (6/24/04)	10[e]	0-8	8-35	35-500
15997	740	NA (6/15/04)	2[e]	0-15	15-35	35-740
16051	500	NA (6/29/04)	9[e]	0-25	25-360	360-500
16446	1,000	NA (3/1/05)	1[e]	0-15	15-420	420-1,000
18495	700	NA (9/18/07)	8[e]	0-2	2-25	25-700
19614	170	70 (12/19/73)	6[e]	0-1	1-20	20-170

— Not Encountered

[a] Well No. 2 was reported by the Water Well Drillers Report to be originally 520 feet deep.

[b] Well No. 4 is reported by the property owner to be 150 feet deep. The well is currently obstructed at 25 feet below top of casing with a pipe from the former windmill that was located on this well.

[c] Property owner reports Well No. 5 was originally 90 feet deep and produces 8 gpm. Well No. 5 was discovered on 10/17/12.

[d] Hand-dug well is dry and obstructed at 25.6 feet bgs. Property owner reports hand-dug well was originally 100 feet deep.

[e] Airlifted production rate recorded at the end of drilling.

[f] Confidential well logs are not correlated with mapped well locations.

2.8 Water Quality

Groundwater quality in the fractured rock aquifers of San Diego County has not been as extensively studied as the alluvial aquifers. Existing water quality data for highly-utilized alluvial aquifers is continually collected by state and local water agencies as well as the California Department of Public Health and the California Department of Water Resources (DWR). Of California's approximately 16,000 public-supply wells, 80% are in groundwater basins designated by DWR and characterized as alluvial aquifers (Wright and Belitz 2011). Fractured rock aquifers, on the other hand, have highly variable and often low production rates. Information on groundwater quality within fractured rock aquifers is scarce and/or not publicly available.

As part of the California Groundwater Ambient Monitoring and Assessment (GAMA) Program, limited data was collected from hard-rock aquifers within the San Diego Drainages Hydrogeologic Province in an attempt to understand potential water quality concerns within the province (Wright and Belitz 2011). The hard rock study area was the largest (at 850 square miles), and the sampled wells (public supply wells) were limited. However, the data may be useful and broadly representative of the Project area because the sampled wells, like at the proposed Project site, are primarily completed within bedrock composed of fractured and decomposed granite.

The results by Wright and Belitz (2011) results provide a general idea of potential groundwater quality concerns existing in the Project area. The results relevant to fractured rock aquifers are summarized below.

- **Inorganic Constituents (with health-based benchmarks)**: One or more of the inorganic constituents with health-based benchmarks (i.e., MCL, Health Advisory Level, Notification Level) were high (relative to those benchmarks) in 25% of the hard rock study area; these included vanadium (V), arsenic (As), and boron (B). Vanadium and As concentrations were not correlated to either urban or agricultural land use, indicating natural sources as the primary contributors of these constituents to groundwater. Boron was positively correlated with urban land uses, suggesting that anthropogenic activities are a contributing source of B to groundwater.
- **Inorganic constituents (with aesthetic benchmarks)**: Inorganic constituents with aesthetic benchmarks that were detected at high relative-concentrations include manganese (Mn) (in 33.3% of the hard rock study area) and total dissolved solids (TDS) (in 16.7% of the hard rock study area). TDS concentrations were correlated to agricultural land use suggesting that agricultural practices are a contributing source of TDS to groundwater. Manganese concentrations were highest in groundwater with low dissolved oxygen and pH indicating that the reductive dissolution of oxyhydroxides in the bedrock may be an important mechanism for the mobilization of Mn in groundwater. TDS concentrations were highest in shallow wells and in modern (< 50 years) groundwater, which indicates anthropogenic activities are a source of TDS concentrations in groundwater.
- **Organic constituents**: Concentrations of organic constituents above the health-based benchmarks were not detected.

The study also indicated that several samples in the hard rock study area had radioactive elements in the medium (gross alpha) to high (radon 222) range (Wright and Belitz 2011). According to Figure 4 of the San Diego County Guidelines, the Project site is not located within an area identified as being a problem area for nitrates and radioactive elements (County of San Diego 2009). This does not necessarily indicate that nitrates and radioactive elements are absent from the Project site, but that it is not in an area that has been sampled and where a problem has been identified.

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3.0 WATER QUANTITY IMPACT ANALYSIS

This section discusses the potential impacts of the Project on local groundwater resources in terms of the County PDS significance criteria.

3.1 50% Reduction of Groundwater in Storage

Due to limited area and the relatively small water requirement of the Project compared to the volume of groundwater in storage within the Hipass Hydrologic Subarea, an analysis was performed for the area surrounding the proposed supply Well B, extending out to a 0.5-mile radius, as per consultation with the County Groundwater Geologist. The 0.5-mile radius area surrounding the pumping well comprises 503 acres, with approximately 48 acres extending beyond the Unites States border into Mexico. These 48 acres are not included in the analysis. Thus an approximately 455-acre area defines the groundwater resource study area used in this analysis (as shown in Figure 10).

3.1.1 Guidelines for Determination of Significance

The following requirement is set forth in the County of San Diego Guidelines (2007):

> For proposed projects in fractured rock and sedimentary basins, groundwater impacts will be considered significant if a soil moisture balance, or equivalent analysis, conducted using a minimum of 30 years of precipitation data, including drought periods, concludes that at any time groundwater in storage is reduced to a level of 50% or less as a result of groundwater extraction.

A project-specific soil moisture-based water balance analysis was performed. The analysis evaluates whether the construction and subsequent operational water demands for the Project maintain at least 50% groundwater in storage over the 455-acre project groundwater resource area after 1 year of Project construction and 29 years of Project operation.

3.1.2 Methodology

A soil moisture balance method was used to evaluate rainfall recharge within the 0.5 mile radius groundwater resource study area surrounding Well B. The calculation assumes that no net flow of groundwater into or out of the 0.5-mile radius study area from larger distances in response to local groundwater pumping drawdown. Rainfall, runoff, evapotranspiration, and groundwater recharge was calculated in monthly intervals using historical rainfall data for a span of 30 years, which includes historical periods of elevated rainfall and drought. Pumping-induced changes to the volume of groundwater in storage over the 30-year period

within the 0.5-mile study area were evaluated for three scenarios as described in Section 3.1.2.2. By comparing the cumulative depletion in storage to the maximum volume of water potentially available as groundwater storage, a determination as to whether the 50% reduction significance threshold occurs can be made.

The study area was defined by the horizontal radial boundary of 0.5 mile around Well B (Figure 10). The aquifer storage capacity is defined based on the currently estimated aquifer saturated thickness per hydrologic unit, here conservatively assumed to be 1 foot for alluvium, 5 feet for decomposed granite (DG), and 500 feet for fractured rock.

3.1.2.1 Groundwater Recharge

Groundwater recharge for the 0.5 mile study area around Well B was estimated using a monthly soil-moisture balance approach based on the computer code provided in the San Diego County Department of Planning and Land Use (DPLU) General Plan Update Groundwater Study (County of San Diego 2009) and similar to the methodology used in the RECHARG2 program developed by Dr. David Huntley at San Diego State University (SDSU). Groundwater recharge occurs when the amount of rainfall entering the area exceeds the amount subsequently lost to runoff and evapotranspiration and the soil moisture capacity is met. The monthly recharge equation is as follows:

$$\textbf{Recharge}(i) = \textbf{PPT}(i) - \textbf{RO}(i) - \textbf{PET}(i) - (\textbf{SMC} - \textbf{SM}(i))$$

where:

Recharge(i) = Recharge during month i
PPT(i) = Rainfall during month i
RO(i) = Runoff during month i
PET(i) = Potential Evapotranspiration during month i
SMC = Soil Moisture Capacity
SM(i) = Soil Moisture at beginning of month i

Excel spreadsheets were developed for data input, groundwater recharge calculations, and the comparison of the cumulative effect on groundwater in storage.

Data Compilation

The data required to provide groundwater recharge estimates were obtained from various sources and are discussed as follows:

Precipitation

Monthly rainfall data for a 30-year period, July 1982 through July 2012, were used in this analysis. The data were collected at the gauging station located in Tierra del Sol as depicted in Figure 4. The Tierra del Sol precipitation data were provided by the County of San Diego (Rand, pers. comm. 2012). There are 15 monthly records out of 361 total data points for which data was not recorded. In such instances, a value of 0 inches was conservatively assigned where rainfall data could not otherwise be obtained. As discussed in Section 2.2, the Tierra del Sol precipitation data underestimates precipitation falling on the area by 20% to 27% due to its location on a ridgeline. Therefore, the precipitation data used is this analysis likely underestimates recharge. The Campo precipitation data from the last 30-year period, July 1982 through July 2012, has been supplemented to the water balance analysis to determine recharge based on the greater precipitation recorded at this rain gauge. Precipitation measured at Campo Station from 1982 to 2012 indicates an average annual precipitation of 15.4 inches, as compared to only 11.3 inches at Tierra del Sol over the same 30-year period.

Evapotranspiration

Reference evapotranspiration (ETo) data are provided by CIMIS throughout the state of California. CIMIS maintains a number of weather stations statewide that provide the meteorological parameters used to calculate published reference ETo values. These ETo values are dependent on parameters including incident solar radiation, vapor pressure, air temperature, and cloud cover. The ETo values published by CIMIS and used in this analysis overestimate actual rates of evapotranspiration at the Project site because the CIMIS ETo is a calculated water need for well-watered grass rather than for non-irrigated native vegetation and soil. CIMIS has designated the area surrounding the Project site as Zone 16 (CIMIS 1999). The monthly average ETo values provided by CIMIS for Zone 16 were used in this analysis. The total annual ETo for Zone 16 is reported as 62.5 inches/year (CIMIS 1999).

Soil Moisture Capacity

Soil moisture capacity or water-holding capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point (USDA 1973). Soil water-holding capacity is dependent on the soil type and site-specific soil properties, including rock fragments, organic matter, bulk density, osmotic pressure, texture, and rooting depth (USDA 1998). The USDA has defined a range of water-holding capacity values for each type of soil present in San Diego County (USDA 1973). The mean value of the reported range of values for each soil type was used as the soil moisture capacity for this analysis. Soil type and coverage on the Project site were based on the USDA mapping (Figure 7). Water holding capacity by soil type is provided in Table 3-1.

Runoff

Because there are no stream gaging stations in close proximity to the Project site and due to the limited size of the groundwater resource study area for this Project, runoff must be estimated. The estimated runoff values used in this analysis are derived from the Natural Resources Conservation Service (NRCS) curve number method (CNM) as expounded in the County of San Diego Hydrology Manual (2003). The CNM was designed to estimate runoff for watersheds in which no direct measurement was available. The CNM is based on a simplified infiltration model of runoff and empirical approximations.

In order to compute runoff (Q) using the CNM, two parameters must be known: precipitation (P) and the maximum soil moisture retention after runoff has begun (S), based on the following relationship.

$$Q = (P-0.2S)^2/(P+0.8S)$$

The monthly precipitation data used is the 30-year period (1982–2012) of record for the Tierra del Sol gauging station provided by the County of San Diego (Rand, pers. comm. 2012). The maximum soil moisture retention (S) is a function of soil type, with all soils having been classified into one of four hydrologic groups, A through D. Soils are classified by the USDA's NRCS into four hydrologic soil groups based on the soil's runoff potential. The four hydrologic soils groups are A, B, C, and D. Group A generally has the smallest runoff potential, highest infiltration rates and group D the greatest runoff potential, lowest infiltration rates, and lowest soil moisture retention. The soils within the 0.5-mile radius surrounding Well B fall into hydrologic groups A (57%) and B (43%), as shown in Table 3-1.

Table 3-1
Soil Types and Soil Moisture-Holding Capacities

Soil Symbol	Soil Name and Description	Hydrologic Soil Group	Soil Water Holding Capacity (inches)	Mean Soil Water Holding Capacity (inches)	Area (Acres)	Percent of Total Area Examined
KcC	Kitchen Creek loamy coarse sand, 5%–9% slope	B	3–5.5	4.25	193.7	43%
LcE2	La Posta rocky loamy coarse sand, 5%–30% slope, eroded	A	1–2	1.5	118.9	26%
MvC	Mottsville loamy coarse sand, 2%–9% slope	A	4–5	4.5	142.6	31%

Source: USDA 1973, Soil Survey San Diego Area, California

The CNM requires the selection of a curve number based on a combination of soil conditions, land use (ground cover), and hydrologic conditions to assign a runoff factor to the area. These runoff factors, called runoff curve numbers (CNs), indicate the runoff potential of an area. The higher the

CN, the higher the runoff potential (County of San Diego 2003). Based on a desert shrub ground cover and good hydrologic condition, CNs developed for soil groups A and B are 49 and 68, respectively (Table 4-2 of the County Hydrology Manual, County of San Diego 2003).

The maximum soil moisture retention (S) is calculated from the curve numbers based on the following relationship:

$$S = 1000/CN-10$$

Using the monthly precipitation record and the assigned curve numbers, anticipated monthly runoff values for the Project area were calculated for the 30-year period of record of the precipitation data. A calibration analysis included in the 2010 General Plan Update Groundwater Study (County of San Diego 2009) compared the runoff values using the NRCS curve number method to existing conditions for periods when historical groundwater level data were available in the Lee Valley Basin. The County concluded that runoff values calculated using the NRCS curve number method were overestimated. A reasonable relative match between calculated groundwater in storage compared to historical groundwater levels was obtained by applying an adjustment factor of 0.5 to the calculated runoff values. This adjustment factor of 0.5 was used in this analysis. The runoff calculated for the 0.5 mile radius around Well B is approximately 14 inches over the 30 years simulation period, or 0.5 inches per year. Annual rainfall is approximately 12 inches per year. Thus, the runoff is approximately 4% of the rainfall for this study. Calculations are provided in Appendix C.

3.1.2.2 Groundwater Demand

Groundwater demand was evaluated for three scenarios using both the Tierra del Sol and Campo 30 year precipitation data as follows:

1. Water demand based on existing use.
2. Water demand of the combined existing use and Project water demand.
3. Water demand of the combined existing use, Project water demand and full General Plan build-out.

Scenario 1 evaluates groundwater recharge based on the existing 6 residences with an assumed water demand of 0.5 afy per residence, for a combined total water demand of 3 afy (Table 3-2).[1]

Table 3-2
Scenario 1—Existing Conditions

[1] For residential uses, the County assumes an annual consumptive use of 0.5 acre-feet (163,000 gallons) of water per dwelling unit (County of San Diego 2013).

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Total Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Single-Family Residential Units	6	0.5	3	90
Total Existing Water Demand Under Scenario 1				**90**

Scenario 2 evaluates groundwater recharge based on the combined water demand of the existing 6 residences (each requiring 0.5 afy), the water provided by Well B during the construction phase of the Project (18 acre-feet), and the Project operational water demand (6 afy) provided from Well B after construction (Table 3-3).

Table 3-3
Scenario 2—Existing and Proposed Project Conditions

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Single-Family Residential Units	6	0.5	3	90
Tierra del Sol Solar Farm Operational Demand [a]	1	6	6	174
One-time Demand for Construction				
Tierra del Sol Solar Farm Construction Demand (Well B) [b]	1	18	18	18
Total Water Demand Under Scenario 2[c]			**9**	**282**

[a] Operational water demand requires approximately 6 afy x 29 years = 174 acre-feet.
[b] Construction water demand requires a one-time extraction of approximately 18 acre-feet.
[c] Includes existing, construction, and operational water demands over 30-year period evaluated (1 year construction + 29 years operation).

Scenario 3 evaluates groundwater recharge based on the water demand of the existing 6 residences (each requiring 0.5 afy), the proposed Project, which requires an estimated one-time demand of 18 acre-feet supplied from Well B for construction and 6 afy thereafter for operation, combined with the full buildout of the existing General Plan (Table 3-4). The General Plan specifies the land zoning north of Well B as rural residential with a density of 1 unit per 20 acres (i.e., RL-20). The land east of Well B is zoned as RL-80, or 1 unit per 80 acres (County of San Diego 2012); (Figure 5).

Table 3-4
Scenario 3—Existing and Proposed Project Conditions with Full General Plan Buildout

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Single-Family Residential Units	6	0.5	3	90
Tierra del Sol Solar Farm Operational Demand[a]	1	6	6	174
Additional Single-Family Residential Units (at Full General Plan Buildout)	2	0.5	1	30
One-time Demand for Construction				
Tierra del Sol Solar Farm Construction Demand[b]	1	18	18	18
Total Water Demand Under Scenario 3[c]			**10**	**312**

[a] Operational water demand requires approximately 6 afy x 29 years = 174 acre-feet.
[b] Construction water demand requires a one-time extraction of approximately 18 acre-feet.
[c] Includes existing, construction and operational water demands over 30-year period evaluated (1 year construction + 29 years operation).

3.1.2.3 Groundwater in Storage

The groundwater storage capacity was calculated using conservative estimates of the saturated thickness of the three hydrologic units (alluvium, DG, and fractured granitic bedrock) underlying the 455-acre area in the 0.5-mile radius of the groundwater resource study area. For this analysis, the saturated thicknesses of the alluvium, DG, and fractured granitic rock were assumed to be uniform at 1 foot, 5 feet, and 500 feet, respectively. The estimated specific yields for each hydrologic unit were obtained from County guidelines (County of San Diego 2007, 2010b). The specific yield associated with the alluvium is 10%. The specific yield for the residuum is 5%. The specific yield for fractured bedrock is 0.10%. By multiplying the acreage of the study area by the estimated specific yield and by the saturated thickness for each hydrogeologic unit, the total groundwater in storage within the 0.5-mile study area contained within the United States is estimated to be 387 acre-feet. By hydrologic unit, the alluvium, saturated DG, and fractured granitic rock storage is 45 acre-feet, 114 acre-feet, and 228 acre-feet, respectively.

3.1.2.4 Long-Term Groundwater Availability

Long-term groundwater availability was evaluated using the calculated groundwater recharge, the estimated water demand detailed in three scenarios (described in Section 3.1.2.2) and the calculated maximum groundwater storage capacity (Section 3.1.2.3). The volume of groundwater in storage varies depending on the rate of recharge and the volume of water pumped from storage (water demand). Excel spreadsheets showing the calculations of the 30 year study period are provided in Appendix C. The Project has an estimated annual water demand of 6 afy as well as a one-time/ short-term project construction demand of 18

acre-feet, which will be extracted over an approximate 1 year construction period. To conservatively incorporate this one-time extraction into the analysis, the water demand of 18 acre-feet was removed during a drought period starting in July 1983 for the Tierra del Sol and Campo precipitation records used in this analysis.

3.1.3 Significance of Impacts Prior to Mitigation

The results of the analysis show that for each of the three water demand scenarios involving the Project, the volume of groundwater in storage remains above the 50% significance threshold. The calculated maximum volume of groundwater in storage within the upper 500 feet of the aquifer is approximately 387 acre-feet.

Exhibits 3-A, 3-B, and 3-C present the amount of groundwater in storage over a 30-year record of precipitation/recharge for Scenario 1, Scenario 2, and Scenario 3, respectively. As shown in Table 3-5, the minimum volume of groundwater in storage over the 30-year period was approximately 367 acre-feet, or 95% of the initial groundwater storage capacity under Scenario 1. Under scenario 2, the minimum volume of groundwater in storage over the 30-year period was approximately 319 acre-feet, or 82% of the initial groundwater storage capacity. Scenario 3 is the most water-intensive, and results in a minimum volume of groundwater in storage over the 30 year period of approximately 311 acre-feet, or 80% of the initial groundwater storage capacity.

Table 3-5
Groundwater in Storage by Scenario for Wells 6a and 6b

	Scenario 1a Existing Conditions[a]	Scenario 1b Existing Conditions[b]	Scenario 2a Existing Conditions with Project[a]	Scenario 2b Existing Conditions with Project[b]	Scenario 3a Existing Conditions with Project and General Plan Build-out[a]	Scenario 3b Existing Conditions with Project and General Plan Build-out[b]
Minimum (af)	367	376	319	332	311	324
Maximum (af)	387	387	387	387	387	387
Average (af)	381	384	363	372	361	370
Percent Minimum Groundwater in Storage Over 30-year Period	**95**	**97**	**82**	**86**	**80**	**84**

[a] Groundwater storage results based on using precipitation data from the Tierra del Sol rain gauge.
[b] Groundwater storage results based on using precipitation data from the Campo rain gauge.

Exhibit 3-A
Scenario 1—Existing Demand Groundwater in Storage

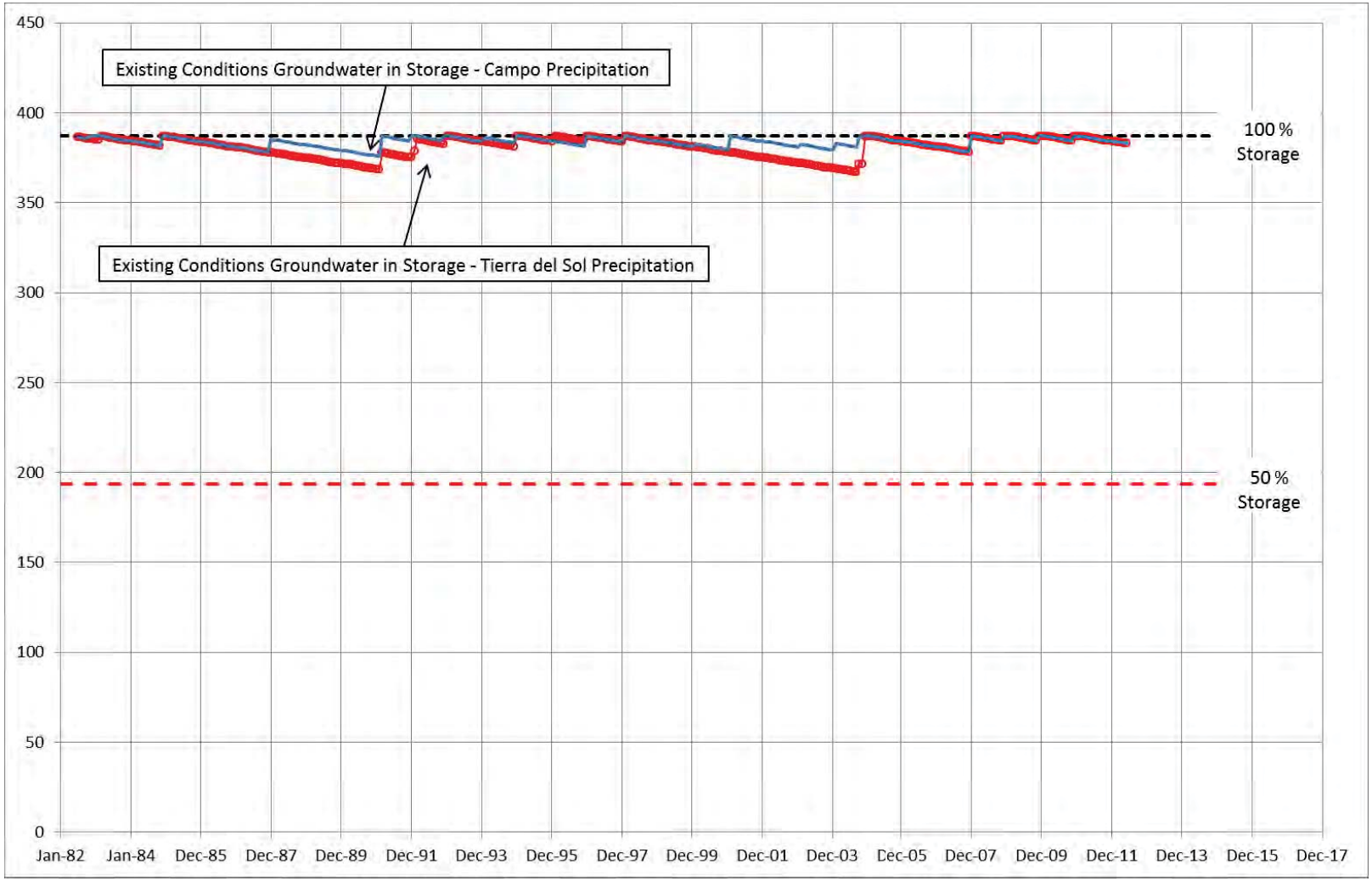


Exhibit 3-B
Scenario 2 - Existing and Project Demand Groundwater in Storage

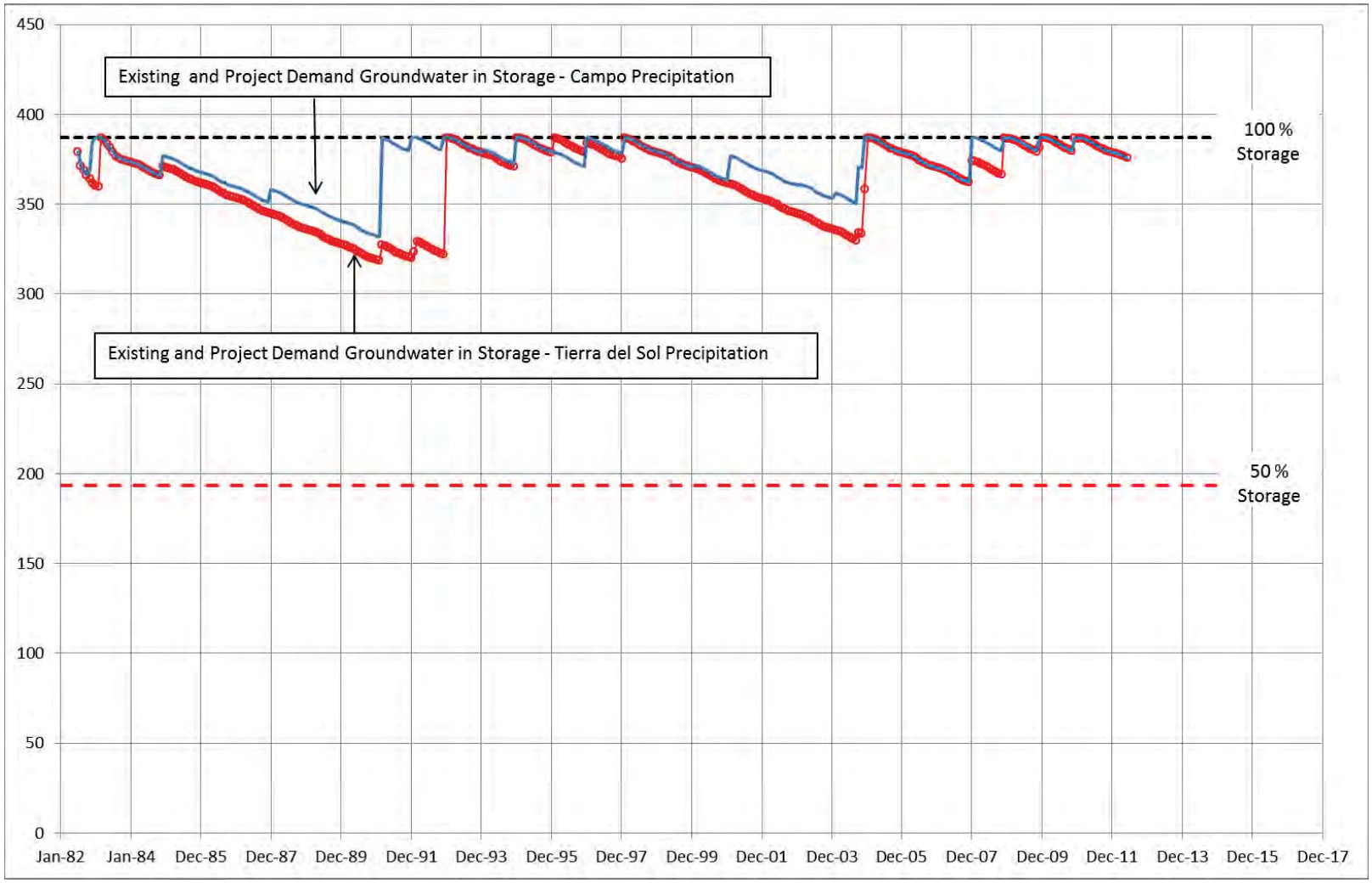
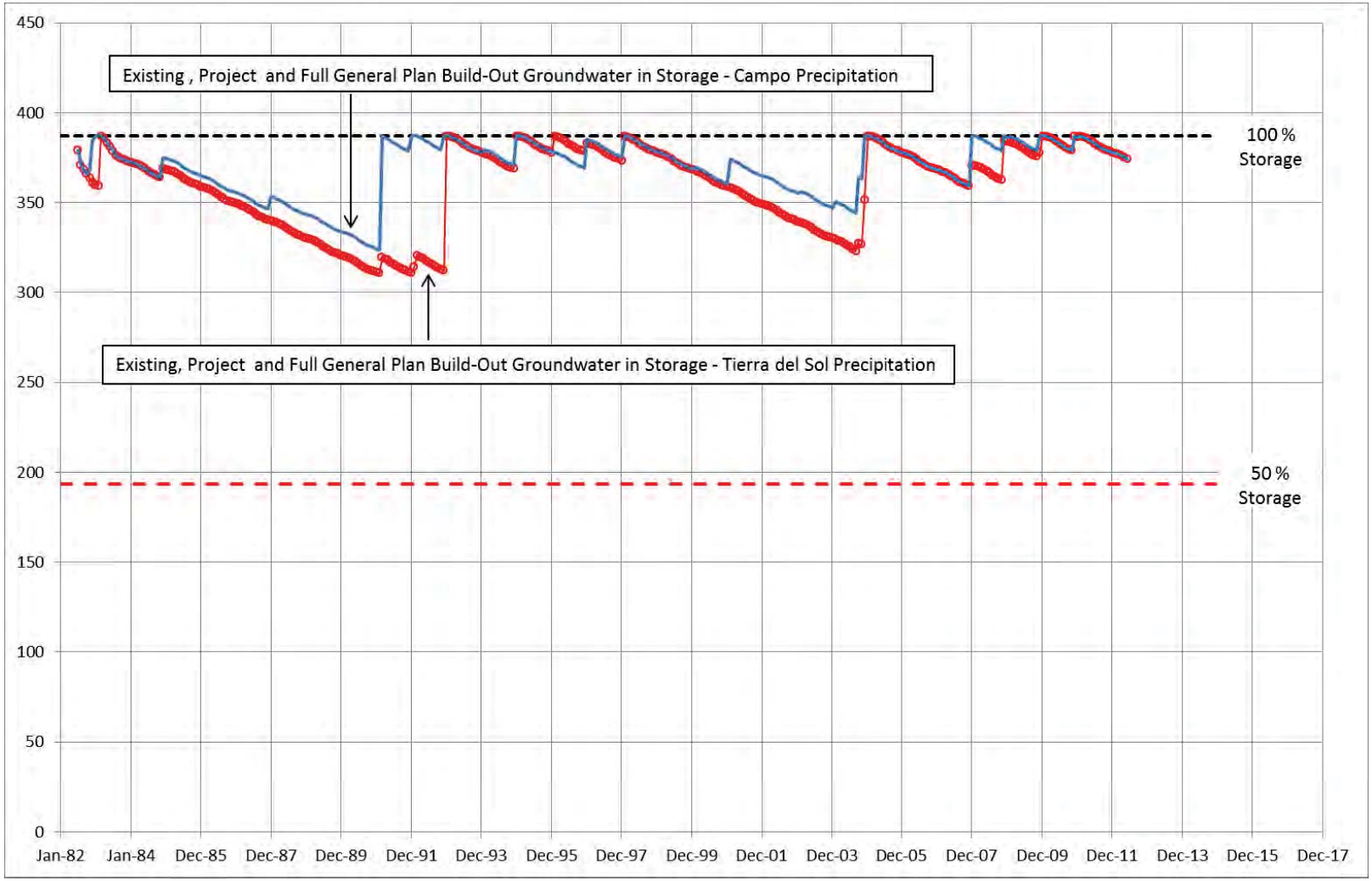


Exhibit 3-C
Scenario 3—Existing, Project and Full General Plan Buildout Demand Groundwater in Storage



3.1.4 Mitigation Measures and Design Considerations

Because actual conditions during groundwater extraction for the Project may vary from the above analysis, a Groundwater Monitoring and Mitigation Plan (GMMP) will be prepared to ensure that pumping does not unduly impact existing well users. The GMMP will include monitoring the duration and rate of pumping in order to verify the total volume of groundwater removed, and water level monitoring from the pumping well, on-site wells, and off-site wells. The GMMP is described in greater detail under Section 3.2.4 because it is being developed primarily to address the potential for well interference and potential effects on groundwater-dependent habitat.

3.1.5 Conclusions

The proposed Project is determined to have a less-than-significant impact to groundwater storage, as defined by the PDS County guidelines.

3.2 Well Testing

3.2.1 Guidelines for Determination of Significance

3.2.1.1 Well Interference in Fractured Rock

The following significant impact requirement is set forth in the County of San Diego Guidelines (2007):

> As an initial screening tool, off-site well interference will be considered a significant impact if after a five year projection of drawdown, the results indicate a decrease in water level of 20 feet or more in the off-site wells. If site-specific data indicate water bearing fractures exist which substantiate an interval of more than 400 feet between the static water level in each off-site well and the deepest major water bearing fracture in the well(s), a decrease in saturated thickness of 5% or more in the off-site wells would be considered a significant impact.

According to the County Groundwater Geologist, who was the primary author of the County of San Diego Guidelines, the intent of the above guideline was to cover projects that have continual ongoing water uses that remain static over time. Such projects have, historically comprised the majority of the groundwater dependent projects processed by the County. In recent years, alternative energy projects have proposed producing a relatively large amount of water during the construction portion of the project, which could potentially cause direct well interference impacts from the water demand in these short periods. Therefore, to evaluate

potential impacts from short-term pumping of groundwater, the County Groundwater Geologist has requested that in addition to the 5 year projection of drawdown, that a short-term 90 day drawdown analysis to evaluate the peak construction demand for this project and a 1 year drawdown analysis to evaluate the entire construction demand be provided.

The closest wells to the pumping well (Well B) are off-site private wells RM-1, RM-2, RM-3 and RSD-1 (Figure 10). RM-1 and RM-2 are located approximately 784 feet north of Well B and are completed to a total depth of 147 and 200 feet bgs, respectively. RM-3 is located approximately 917 feet northeast of Well B and is completed to a total depth of 155 feet bgs. RSD-1 is located approximately 2,539 feet north of Well B and is completed to a total depth of 299 feet bgs. An additional four wells were identified from confidential well logs and a site reconnaissance within a 0.5 mile radius of Well B as indicated in Table 3-6.

Table 3-6
Well B Well Users within 0.5 Mile Radius

Well Number	APN	Use	Distance from Well B
RM-1 and RM-2	658-090-30	Domestic	784
RM-3	659-130-01	Agriculture	917
RSD-1	658-090-51	Domestic	2,539
Off-site Confidential Wells[d]			
645		Domestic	861[a]
CW-1[c]		Agriculture	1,713
4133		Domestic	2,617[b]
18495		Domestic	2,707[b]

[a] Reported distance is to property line as the exact well location is unknown.
[b] Approximate well location observed in the field.
[c] Property owner choose not to participate in water level monitoring.
[d] Assessor parcel numbers are redacted for confidential well logs.

Well B is completed to a total depth of 1,311 feet bgs. The primary water producing fractures were encountered at 1,000, 1,195 and 1,245 feet bgs. Well B was pumped continuously for 12 hours at increasing pumping rates on October 16, 2012, during the 12-hour step test used to evaluate the well production characteristics. Based on the step test results, Well B was pumped continuously at an average rate of 61 gpm for 72 hours beginning on October 22, 2012, for the constant rate discharge test. All on-site wells and 11 off-site wells (including RM-1, RM-3 and RSD-1; see Figure 10) were equipped with pressure transducers to observe the effects of the pumping on water levels. No drawdown was observed in any on-site or off-site wells during pumping at Well B. Fluctuations due to residential or irrigation pumping were observed in several off-site wells. In the wells that exhibit these expected changes in water level, fluctuations were observed over the entire

monitoring period. Wells were monitored for over one month, spanning the time period before, during, and after the pumping at Well B. Based on the results of on-site and off-site groundwater elevation monitoring, no well interference was observed during the 72 hour pump test of Well B.

To estimate the longer-term potential for well interference during Project groundwater pumping, drawdown at the nearest domestic well was estimated using the Cooper-Jacob approximation of the Theis non-equilibrium flow equation (Cooper 1953). A five-year period was used to calculate the potential long-term impact using the drawdown calculation methodology. It is likely to overestimate potential drawdown with distance over time for the following reasons:

- The calculations assume no rainfall recharge occurs over the 5-year period. Recharge will offset water level decline related to groundwater extraction during periods of above average annual rainfall (non-drought conditions).
- The well is located approximately 700 feet southwest of an intermittent stream (Figure 7) that will, at times, be an additional source of water to the well and offset drawdown (a recharge boundary condition).
- There was no discernible water level changes observed in the on-site and off-site monitored wells during hydraulic testing of Well B.

The total groundwater production demand supplied from Well B for the Project is estimated at 18 acre-feet over approximately the first year for construction and 6 afy thereafter for operation over a 30 year project life. Thus, the total Well B proposed project water demand is 192 acre-feet over the life of the project as indicated in Table 3-7.

Table 3-7
Well B Project Pumping Demand

Project Activity	Water Demand (acre-feet/year)	Years	Water Demand Amortized over Year (gallons per minute)	Total Water Demand Over 30 Years (acre-feet)
Peak Construction Demand	7 (90 days)	(90 days)	18 (90 days)	NA
Construction	18	1	11.2	18
Operation	6	29	3.7	174
Total Well B Proposed Project Water Demand				**192**

Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, drawdown due to Project construction (Year 1) at the nearest residential wells (RM-1 and RM-2), both located approximately 784 feet from Well B, is projected at 19.9

feet. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown at Wells RM-1 and RM-2 is projected at 14 feet (Table 3-11). Thus, well interference is not predicted to exceed the County threshold of significance that results in a decrease in water level of 20 feet or more in the off-site wells after a 5-year projection of drawdown. This is considered a less-than-significant impact based on County of San Diego well interference threshold.

3.2.1.2 Groundwater Dependent Habitat

The County's Guideline 4.2.C from the County's Biological Guidelines for Determining Significance defines the following threshold for determining a significant impact to riparian habitat or a sensitive natural community:

> The project would draw down the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historical low groundwater levels.[2]

Potential groundwater-dependent vegetation habitats occurring on and near the Project site are depicted in Figure 11. Two vegetation habitats have been identified on the Project site and in the Project vicinity that may depend on groundwater. These vegetation types include coast live oak woodland and open water.

***Quercus agrifolia* (coast live oak)** is a native, drought-resistant, evergreen tree with a root system that consists of a deep taproot with several main roots that may tap groundwater if present within approximately 36 feet of the soil surface (Robinson 1958; Canadell 1996; Steinberg 2002).

The majority of coast live oak and mixed oak woodland is mapped northeast of Well B on a parcel adjacent to the Project site. The coast live oak or mixed oak woodland appears to be approximately coincident with the alluvial soils identified on Figure 7 (see unit MvC—Mottsville loamy coarse sand).

Open water consists of bodies of fresh water (extremely low salinity) in the form of lakes, streams, ponds, or rivers (Oberbauer et al. 2008). Open water areas are aquatic areas that generally lack emergent vegetation, but typically support hydrophytic vegetation around their margins (e.g., mulefat scrub, southern willow scrub, freshwater marsh, or herbaceous wetland).

[2] The historical low groundwater levels in the vicinity of the Project site are unknown. Historical water level hydrographs compiled for the Boulevard Planning Group –Tierra del Sol from 1993 to 2008 indicate up to 35 feet of water level decline in one well during this period of measurement (Figure 2-34; County of San Diego 2009).

The open water area occurs in the central-eastern portion of the Project site and is a stock pond formed by a manufactured bank along the east side of the area. The lowest portion of the depressional feature is characterized by cracked soils, mostly lacking any vegetation. A surrounding ring of herbaceous vegetation is dominated by rabbit's foot grass (*Polypogon monspeliensis*) and black mustard (*Brassica nigra*). The open water area does not meet California Department of Fish and Game (CDFG) jurisdictional criteria because it is not associated with a lake or streambed. No wetlands or waters of the United States under the jurisdiction of the U.S. Army Corps of Engineers (ACOE), Regional Water Quality Control Board (RWQCB), CDFG, or County were identified on site (Dudek 2012b).

As no drawdown was observed in on-site shallow wells (Wells 1, 4, and 5) or the nearest off-site shallow wells (Wells RM-2 and RM-3), it is possible that there is limited hydraulic connection between primary producing fractures of the pumping well at greater than 1,000 feet bgs and the shallow aquifer system. Given hydrogeologic conditions and the limited duration of the 72 hour constant rate test it is uncertain whether there is hydraulic isolation of the shallow alluvial aquifer associated with Rattlesnake Creek from the deep fractured bedrock aquifer. As projected by the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, the maximum expected drawdown at Well RM-3 (located within area identified with groundwater dependent habitat) is 18.3 feet during the approximate 1 year Project construction period (Table 3-11). Therefore, Project well production may exceed the County threshold of significance that results in drawdown of the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historical low groundwater levels.

3.2.2 Well B Testing Methodology

The following sections (3.2.2.1 and 3.2.2.2) describe the procedures followed during the aquifer testing at Well B. Well B is located on the northeastern portion of the Project site (Figure 10). Stehly Brothers Drilling Inc. drilled and completed Well B between April 2012 and July 2012.

3.2.2.1 Well Test Description

A 12-hour step test was performed at Well B on October 16, 2012, from 9:17 through 21:19. The purpose of this step-drawdown test was to establish an optimal pumping rate for the 72-hour aquifer test. The 72-hour aquifer test was performed at Well B beginning October 22, 2012, at 12:00 and ending on October 25, 2012, at 12:00. The 72-hour aquifer test was performed to determine the feasibility of groundwater use for on-site construction and operational water supply and to characterize the hydraulic properties of the aquifer in the vicinity of the well. Tables 3-8 and 3-9 summarize the simplified lithology and completion materials of Well B.

Water quality samples were collected on October 24, 2012, at 11:00. The results of the water quality analysis are described in detail in Section 4.2.2.

Table 3-8
Well B Simplified Lithologic Log

Depth (Feet, bgs)	Description
0–1,086	Weathered and Unweathered White Granitic Rock – Tonalite
1,086–1,111	White Granitic Rock – Granodiorite
1,111–1,236	Angular White Granitic Rock – Tonalite
1,236–1,311	White Granitic Rock – Granodiorite

Table 3-9
Well B Completion Details

Depth (Feet, bgs)	Borehole Diameter (Inches)	Casing and Materials
0–53	16	10.75-inch O.D. by 0.250-inch wall California Steel Industries A 53 Grade B Mild Steel Casing
0–53	16	Cement
53–1,019	10	8-inch O.D. by 0.188-inch wall NEXSTEEL Mild Steel Casing
1,019–1,311	6.625	Open-cased, granite borehole

Prior to the 12-hour step test, a Goulds Model 65L20 submersible pump and Franklin 20 horsepower (HP) submersible motor were installed in Well B to a depth of 900 feet. An In-Situ, Inc. (In-Situ) Level Troll 700 pressure transducer was installed 794 feet below the top of casing (btoc) in a one inch sounding tube in Well B on August 22, 2012. Additionally, pressure transducers were installed in each of the six on-site observation wells (Well 1, Well 2, Well 3, Well 4, Well 5, and Well A, depicted on Figure 9). An In-Situ BaroTroll and a Solinst Barologger were stored in a locked electrical box on site and used to measure barometric pressure before, during, and after the 12-hour and 72-hour tests. The pressure transducer data collected in the pumping well and observation wells were corrected using this barometric data. Manual water level measurements were recorded prior to the test, at the start of the test, periodically over the test interval, and during recovery after pumping ceased (Appendix D). Flow and total gallons pumped were measured using an in-line flow meter equipped with a flow totalizer.

Pressure transducers were installed in 11 off-site wells (GR-1, GS-1, GS-2, LK-1, RM-1, RM-3, RSD-1, RSH-1, RSH-2, RSH-3, and WHH-1, Figure 10). The off-site wells are all residential-

use water wells located on private residences adjacent to or near the Project site. The off-site residential water wells range in depth from 20 to 450 feet bgs (Table 2-8). These wells were equipped with pressure transducers in order to quantify the effects, if any, of the drawdown induced by the aquifer test. Automatic water level readings were recorded every 15 minutes prior to, during, and after the pump test by the pressure transducers installed in the off-site wells. Multiple manual water level measurements were obtained in the off-site wells, including at the time of transducer installation and at time of data downloads from pressure transducers.

The static water level in Well B prior to the start of the 72-hour test was measured at 49.92 feet btoc. The 72-hour constant rate aquifer test commenced on October 22, 2012, at 12:00. Well B was pumped at an average flow rate of 61 gpm over the duration of the test. The total volume of water pumped over the 72-hour period of the test was 264,675 gallons. The pumped water was discharged to a stock pond located approximately 400 feet east of Well B under Conditional Waiver No. 2 submitted to the RWQCB (Appendix E).

3.2.2.2 Well Test Analysis

The results of the Well B aquifer test are presented graphically in Figures 30 through 34. Aquifer transmissivity (the rate at which water flows through a vertical strip of the aquifer 1-foot wide and extending through the full saturated thickness, under a hydraulic gradient of 1 or 100%) is calculated using the Cooper–Jacob approximation to the Theis equation (Cooper and Jacob 1953) as follows:

$$T = \frac{2.303\ Q}{4\ \pi\ \Delta s}$$

Where:

T = transmissivity (feet^2/day) [multiply by 7.48 to get units of gpd/foot]
Q = average pumping rate (feet^2/day) [multiply gpm by 193]
π = pi (3.14)
Δs = difference in drawdown over one log cycle (feet)

The transmissivity (T) calculated for Well B is 30.8 feet^2/day or 230.4 gallons per day/foot (gpd/ft); (Figure 33). Additionally, the aquifer test data were analyzed using the computer program Aqtesolv Pro, version 4.50 (Aqtesolv). The pumping data required for this modeling software included the water level in the pumping well, the rate of pumping, and elapsed time of pumping. The transmissivity values obtained through the Aqtesolv modeling software ranged from 27.3 feet^2/day to 33.48 feet^2/day (204.2 to 250.4 in gpd/ft). The transmissivity estimated for Well B that best fit the data is 31.53 feet^2/day or 235.84 gallons per day/foot (gpd/ft) using the Theis Recovery solution with a sum of squares of 12.07. Table 3-10 shows the range of aquifer parameters and residual statistics obtained from the Aqtesolv modeling.

Table 3-10
Well B: Range of Calculated Transmissivity Values

Solution Method	Parameter Estimates		Residual Statistics				
	Transmissivity (feet²/day)	*Conductivity (feet/day)*	*Sum of Squares (feet2)*	*Variance (feet2)*	*Std. Deviation (feet)*	*Mean (feet)*	*No. of Residuals*
Theis	27.30	0.055	7.60E+06	257	16.03	-2	29574
Theis Recovery	31.53	0.063	12.07	0.01543	0.1242	8.22E-09	784
Cooper–Jacob	27.38	0.055	1.65E+04	0.8283	0.9101	1.19E-08	19919
Gringarten et al.	33.48	0.067	7.61E+06	257	16.04	-1.997	29574
Average Value	**29.92**	**0.06**					

The aquifer coefficient of storage (also called storativity) is the volume of water released from storage per unit decline in hydraulic head in the aquifer per unit area of the aquifer. Due to well losses and inefficiency of the pumping well, an observation well is required to calculate the coefficient of storage. No drawdown was observed in any observation wells. Therefore, the storativity was not calculated.

Projected drawdown to occur in Well B after 1 and 5 years of pumping at a rate of 61 gpm was predicted by forward forecasting using the Cooper-Jacob straight-line method to 1 year (525,949 minutes) and 5 years (2,628,000 minutes). The predicted drawdown at 1 and 5 years is 595 feet and 640 feet, respectively (Figure 33). The Project construction and operational water demands amortized over 5 years is approximately 5.2 gpm. This rate of groundwater production results in projected drawdown of 55 feet in Well B after 5 years.

The closest residential wells (RM-1 and RM-2) are located 784 feet north of pumping Well B. The following estimate of groundwater drawdown at the nearest off-site wells, induced by project pumping, relies on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation (USGS 1962):

$$s = \frac{264\,Q}{T}\log_{10}\frac{0.3\,Tt}{r^2 S}$$

Where:

s = predicted drawdown (feet)
Q = amortized pumping rate (gpm) = 11.2 gpm (year 1), 5.2 gpm (year 5)
T = Transmissivity (gpd/ft) = 31.53 feet^2/day = 235.84 gpd/ft
t = time (days) = Calculated at 365 and 1,825 days
r = distance from pumping well (feet) = varies
S = coefficient of storage (dimensionless) = 0.0010

Drawdown at the closest residential wells (784 feet north) as a result of Project pumping from Well B after 90 days, 1 year and 5 years is predicted to be 19.9 feet, 19.9 feet and 14 feet, respectively. Table 3-11 indicates projected drawdown at select distances from the pumping well using the Cooper-Jacob approximation of the Theis non-equilibrium flow equation.

Table 3-11
Well B Distance Drawdown Calculations

Distance from Pumping Well B (feet)	90 Day Peak Production Drawdown (S=0.001)[a]	u[d]	End Year 1 Drawdown[d] (S=0.001)	u[d]	End Year 5 Drawdown[d] (S=0.001)	u[d]
50	67	0.0002	49.2	0.00005	27	0.00001
100	55	0.0009	41.9	0.00022	24	0.00004
250	40	0.0055	32.1	0.00136	19	0.00027
500	28	0.0220	24.7	0.00543	16	0.00109
634	24	0.0354	22.2	0.00873	15	0.00175
750	21	0.0496	20.4	0.01222	14	0.00244
784 (RM-1 and 2)	19.9	0.0542	19.9	0.01335	14	0.00267
861 (Well 645)	19	Theis[e]	18.9	0.01610	13	0.00322
917 (RM-3)	18	Theis[e]	18.3	0.01827	13	0.00365
1,000	17	Theis[e]	17.3	0.02172	12	0.00434
1,517	11	Theis[e]	12.9	0.05	10	0.01061
1,713 (CW-1)	9	Theis[e]	12	Theis[e]	10	0.01275
2,617 (Well 4133)	4	Theis[e]	8	Theis[e]	7	0.02976
2,707 (Well 18495)	4	Theis[e]	8	Theis[e]	7	0.03184
3,392	2	Theis[e]	6	Theis[e]	6	0.05
5,280 (1-mile)	0.2	Theis[e]	2	Theis[e]	4	Theis[e]

[a] End of peak Project water demand at average pumping rate of 18 gpm over 90 days.
[b] End of year 1 drawdown amortizes construction pumping over 1 year for an average water demand of 11.2 gpm.
[c] End of year 5 drawdown amortizes 1 year of construction water demand with 4 years of operational water demand for an average pumping rate of 5.2 gpm.
[d] u valid if sufficiently small (u < 0.05).
[e] For value of u > 0.05, the Theis solution was used to calculate drawdown.

The Cooper-Jacob method was verified by validating that dimensionless time (u) is sufficiently small (u <0.05) using the equation as follows:

$$u = r^2S/4Tt$$

Where:

u = time (dimensionless)
r = distance to center of pumping (feet) = varies based on Table 3-11
S = Coefficient of Storage (dimensionless) = 0.001
T = transmissivity (feet^2/day) = 31.53 feet^2/day
t = time since pumping started = Calculated at 365 and 1,825 days

The constant T was calculated from Well B during the 72 hour constant rate test. As no observation well responded to Well B pumping, a coefficient of storage of 0.001 was selected as being representative of fractured rock aquifers in San Diego County (County of San Diego 2007, 2010). During a constant rate aquifer test, drawdown data plot on a straight line except at large values of u, or small values of 1/u. At values of u less than about 0.05, the Cooper-Jacob approximation is valid (Driscoll, 2003). Table 3-11 above indicates that the Cooper-Jacob approximation is valid for distances up to 1,517 feet from the pumping well during the first year and up to 3,392 feet through year 5. When the value of u exceeded 0.05, the Theis solution was used to calculate drawdown.

Recovery data were evaluated using the plot of residual drawdown versus time since pumping started divided by time since pumping stopped (t/t') to assess impacts to storage from pumping (Figure 34). At t/t' equals to 1 (infinite time), a residual drawdown would indicate permanent dewatering or incomplete dewatering due to limited extent of the aquifer. The projected residual drawdown at infinite time is negative 5 feet compared to the static water level prior to well testing. However, the projected water level at infinite time is equivalent to the highest static water level measured immediately following drilling and suggests long-term recovery from well pumping.

3.2.3 Significance of Impacts Prior to Mitigation

Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, drawdown due to Project construction (Year 1), at the nearest residential wells (RM-1 and RM-2) both located approximately 784 feet from Well B is projected at 19.9 feet. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown at Wells RM-1 and RM-2 is projected at 14 feet (Table 3-11). Additionally, over the initial 90 day peak production period, drawdown at Wells RM-1 and RM-2 is projected at 19.9 feet. Thus, well interference is not predicted to exceed the County threshold of

significance that results in a decrease in water level of 20 feet or more in the off-site wells after a 5-year projection of drawdown.

As no drawdown was observed in either the on-site shallow wells (Wells 1, 4, and 5) or the nearest off-site shallow wells (Wells RM-1 and RM-3), there may be limited hydraulic connection between primary producing fractures of the pumping well at greater than 1,000 feet bgs and the shallow aquifer system. Given the limited duration of the 72 hour constant rate test, it is uncertain whether there is hydraulic isolation of the shallow alluvial aquifer associated with Rattlesnake Creek from the deep fractured bedrock aquifer. As projected by the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, the theoretical drawdown at Well RM-3 (located within area identified with groundwater dependent habitat) is 18.3 feet after the 1 year construction water demand period (Table 3-11). Therefore, Project well production may exceed the County threshold of significance that results in drawdown of the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historical low groundwater levels.

The well test described and discussed herein satisfies County requirements expounded in Guidelines for Determining Significance and Report Format and Content Requirements – Groundwater Resources (County of San Diego 2007) and County Groundwater Ordinance (Section 67.703.2, County of San Diego 2011). The on-site production well (Well B) is capable of meeting all operational water demand and a portion of the construction water demand of the Project. Any construction water supply deficiencies will be met by importing water from County permitted water sources including off-site groundwater wells or water districts. Water service letters have been obtained from the Jacumba Community Service District, the Live Oak Springs Water Company, Pine Valley Mutual Water Company and the Padre Dam Municipal Water District indicating that they would be willing to supply the project during the Project's peak construction-related water demand.

3.2.4 Mitigation Measures and Design Considerations

As the analysis contained herein is based on limited Project production well testing, monitoring will be conducted to ensure that County well interference significance thresholds are not exceeded. A GMMP has been prepared for the Project (Dudek 2013), which details establishment of groundwater thresholds for off-site well interference and groundwater dependent habitat.

Well Interference: A network of on-site and off-site wells has been established to monitor water levels. Pressure transducers will remain in select on-site and off-site wells to record water level fluctuations. Off-site Wells RM-1, RM-3 and RSD-1 located within half-mile radius

of Well B have been fitted with 1-inch sounding tubes and pressure transducers to record water levels. Manual water level measurements will be recorded with a sounder to confirm transducer accuracy. Baseline water level conditions in RM-1, RM-3 and RSD-1 have been established through water level measurements recorded by the pressure transducers since October 2012. During pumping at Well B, a maximum drawdown of 10 feet below the previously established water level baseline will be allowed in the off-site wells.

Groundwater dependent habitat: Existing off-site monitoring wells RM-1 and RM-3 are located within the coast live oak and mixed oak woodland and the wells are reported to be partially completed within the alluvial aquifer. The historical low groundwater level in the vicinity of the oak woodland is not known over the period corresponding to the lifespan of mature oaks, though water level fluctuations up to 35 feet have been recorded in the Tierra del Sol area (County of San Diego 2009). This lack of historical water level data precludes determination of a water level threshold 3 feet below the historical low. Therefore, routine biological monitoring of the oak woodland for the duration of the 1 year Project construction period will serve as a means to continually assess oak health. Biological monitoring procedures are described in the GMMP. If an International Society of Arboriculture (ISA) Certified Arborist or Registered Profession Forester observes that no impact to the oak woodland has occurred over the construction period, biological monitoring of the oak woodland will cease. In addition to biological monitoring a water level threshold of 10 feet of drawdown below baseline at RM-1 and RM-3 will be established to protect the oaks' ability to continually access groundwater from the alluvial aquifer.

3.2.5 Conclusions

The well test analysis using San Diego County methodology indicated that off-site well interference is not predicted to be an impact for the Project based on Well B operational pumping rates and the 5 year period indicated in the well interference threshold. Additionally, off-site well interference is not predicted to be an impact for the Project based on Well B short-term 90-day peak construction pumping rates or over the entire 1 year construction period. Pressure transducers will remain in several on-site and off-site wells to record water levels during Project construction and operation. A GMMP has been prepared for the Project (Dudek 2013), which details establishment of groundwater thresholds for off-site well interface and groundwater dependent habitat. Annual review of water level data should be conducted by a Certified Hydrogeologist registered in the State of California to evaluate long-term impacts.

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4.0 WATER QUALITY IMPACT ANALYSIS

This section identifies and defines the potential effects of the Project on water quality.

4.1 Guidelines for the Determination of Significance

The Project would result in a significant impact with respect to water quality if the groundwater resources to be used on-site exceed the primary state or federal MCLs for applicable contaminants. The majority of groundwater resources would be utilized for the purposes of dust control during construction and periodic washing of solar panels during long-term Project operations, rather than for the purpose of drinking water. However, potable water will be required to serve the Project's 4 acre O&M annex site, which would house restrooms and other employee support facilities. If the Project cannot demonstrate compliance with applicable MCLs, it will be considered to have a significant impact with respect to groundwater quality.

4.2 Methodology

Sampling procedures and analytical methods used were in compliance with County of San Diego requirements (County of San Diego 2007) and described below. California Department of Public Health (CDPH) regulations pertaining to drinking water were also reviewed. California Code of Regulations (CCR) Sections 64400.80–64445 require monitoring for potable water wells based on the number of connections and number of persons the system serves. As the Project has fewer than 5 connections and will serve fewer than 25 people per day, the Project water system will be classified as an unregulated system (CDPH 2012). The Project will be a non-public state small water system (refer to CCR Sections 64211–64217) regulated by the local primacy agency, the County.

4.2.1 Sampling Procedures

To determine whether the production well for the project (Well B) would exceed applicable MCLs, water samples from Well B were collected on October 24, 2012. Well B had been pumping at an average rate of 61 gpm for 47 hours when the water samples were collected. Therefore, approximately 172,020 gallons were purged from Well B prior to sampling, greatly exceeding the minimum County requirement of two well bore volumes. The samples were placed in laboratory-certified bottles, packed in a cooler with ice, and delivered under chain-of-custody to Enviromatrix Analytical Inc. (Enviromatrix) of San Diego, California, on October 24, 2012, within specified laboratory holding times.

4.2.2 Sampling Analysis

Dudek requested a wide range of water quality analyses from Enviromatrix including nitrate, bacteria (fecal and total coliform), and radionuclide activity, as required under County of San Diego guidelines. Samples were also analyzed for inorganic minerals, volatile organic compounds (VOCs), and general physical/mineral properties. The laboratory report is included as an appendix to this report (Appendix F). Tables 4-1 through 4-6 below list the results of the water quality analyses, analytical method, and comparison to California drinking water primary MCLs and secondary MCLs.

Table 4-1
Microbiological Water Quality Results

Constituent	Analytical Method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
Total Coliform	SM9223	MPN	Absent	More than one sample per month is total coliform positive
E. coli	SM9223	MPN	Absent	A positive result for fecal coliform or E. coli samples is an acute MCL violation

Notes:
MPN = Most Probable Number.
MCL applies after disinfection.

Table 4-2
General Mineral Water Quality Results

Constituent	Analytical Method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
Cations				
Total Hardness	EPA 200.7	mg $CaCO_3$/L	121	—
Calcium	EPA 200.7	mg/L	39.5	—
Magnesium	EPA 200.7	mg/L	5.54	—
Sodium	EPA 200.7	mg/L	53.6	—
Potassium	EPA 200.7	mg/L	1.77	—
Total Cations	*Calculated*	*mg/L*	*4.81*	—
Anions				
Total Alkalinity	SM2320B	mg $CaCO_3$/L	133	—
Hydroxide	SM2320B	mg $CaCO_3$/L	<5	—
Carbonate	SM2320B	mg $CaCO_3$/L	<5	—
Bicarbonate	SM2320B	mg $CaCO_3$/L	133	—
Chloride	SM4500 CL C	mg/L	60	250/500/600[a]

Table 4-2
General Mineral Water Quality Results

Constituent	Analytical Method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
Sulfate	SM4500 S04 E	mg/L	7.7	250/500/600[a]
Fluoride	SM4500 F C	mg/L	0.226	—
Nitrate (as NO_3)	SM4500 N03 E	mg/L	(1.68 as N)	45 (10 as N)
Total Anions	*Calculated*	*me/L*	*4.16*	
Aggregate Properties				
pH	SM2540 C	pH Units	7.68	6.5 – 8.5[b]
Specific Conductance	SM2510 B	umhos/cm	485	900/1,600/2,200[a] (µS/cm)[c]
Solids				
Total Dissolved Solids	SM2540 C	mg/L	277	500/1,000/1,500[a]
General Physical				
Color	SM2120 B	Color Units	5	15
Odor	SM2150 B	T.O.N.	<1.0	3
Turbidity	SM2130 B	NTU	1.87	5

a. Recommended/Upper/Short-Term Secondary MCLs.
b. Secondary MCLs.
c. umhos/cm = µS/cm.

Table 4-3
Inorganic Minerals Water Quality Results

Constituent	Analytical method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
Aluminum	EPA 3010A	ug/L	180	1,000
Antimony	EPA 200.8	ug/L	<10.0	6
Arsenic	EPA 200.8	ug/L	<10.0	10
Barium	EPA 200.8	ug/L	<25	1,000
Beryllium	EPA 200.8	ug/L	<5.0	4
Cadmium	EPA 200.8	ug/L	<5.0	5
Chromium (Total)	EPA 200.8	ug/L	<10.0	50
Copper	EPA 200.8	ug/L	30	1,300[a]
Fluoride	SM4500 F C	mg/L	0.226	2.0[b]
Iron	EPA 3010A	ug/L	250	300[b]
Lead	EPA 200.8	ug/L	<25.0	15[a]
Manganese	EPA 3010A	ug/L	23	50[b]
Mercury	EPA 245.1	ug/L	<0.1	0.002

Table 4-3
Inorganic Minerals Water Quality Results

Constituent	Analytical method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
Nickel	EPA 200.8	ug/L	<25	0.1
Nitrate as $N0_3$ (as N)	SM4500 NO3 E	mg/L	7.4 (1.68)	45 (10 as N)
Nitrite (as nitrogen)	SM4500 NO2 B	mg/L	<0.05	1 (as N)
Nitrate + Nitrite (sum as nitrogen)	Calculated	mg/L	1.68[c]	10 (as N)
Silver	EPA 200.8	ug/L	<25	—
Selenium	EPA 200.8	ug/L	<10	50
Thallium	EPA 200.8	ug/L	<5	2
Zinc	EPA 200.8	ug/L	157	5,000[a]

a. Values referred to as MCLs for lead and copper are not actually MCLs; instead, they are called "Action Levels" under the lead and copper rule.
b. Secondary MCLs.
c. Convert nitrate to nitrate-nitrogen: x mg/L nitrate (NO3) X 0.226 = y mg/L nitrate nitrogen (NO3 – N).

Table 4-4
Volatile Organic Compounds (VOCs) Water Quality Results

Constituent	Analytical Method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
1,1,1-Trichloroethane	EPA 524.2	ug/L	<0.50	200
1,1,2,2-Tetrachloroethane	EPA 524.2	ug/L	<0.50	—
1,1,2-Trichloroethane	EPA 524.2	ug/L	<0.50	5
1,1-Dichloroethane	EPA 524.2	ug/L	<0.50	5
1,1-Dichloroethene	EPA 524.2	ug/L	<0.50	6
1,2,4-Trichlorobenzene	EPA 524.2	ug/L	<0.50	5
1,2,4-Trimethylbenzene	EPA 524.2	ug/L	<0.50	—
1,2-Dichlorobenzene	EPA 524.2	ug/L	<0.50	600
1,2-Dichloroethane	EPA 524.2	ug/L	<0.50	5
1,2-Dichloropropane	EPA 524.2	ug/L	<0.50	5
1,3-Dichloropropene (total)	EPA 524.2	ug/L	<0.50	0.5
1,4-Dichlorobenzene	EPA 524.2	ug/L	<0.50	5
Benzene	EPA 524.2	ug/L	<0.50	1
Bromodichloromethane	EPA 524.2	ug/L	<1.0	—
Bromoform	EPA 524.2	ug/L	<1.0	—
Carbon Tetrachloride	EPA 524.2	ug/L	<0.50	0.5
Chlorobenzene	EPA 524.2	ug/L	<0.50	70
Chloroform	EPA 524.2	ug/L	<1.0	—
cis-1,2-Dichloroethene	EPA 524.2	ug/L	<0.50	6

Table 4-4
Volatile Organic Compounds (VOCs) Water Quality Results

Constituent	Analytical Method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
cis-1,3-Dichloropropene	EPA 524.2	ug/L	<0.50	—
Dibromochloromethane	EPA 524.2	ug/L	<1.0	—
Ethylbenzene	EPA 524.2	ug/L	<0.50	300
Methyl tert butyl Ether	EPA 524.2	ug/L	<3.0	13
Methylene Chloride	EPA 524.2	ug/L	<0.50	5
Styrene	EPA 524.2	ug/L	<0.50	100
Tetrachloroethene	EPA 524.2	ug/L	<0.50	5
Toluene	EPA 524.2	ug/L	0.60	150
trans-1,2-Dichloroethene	EPA 524.2	ug/L	<0.50	10
trans-1,3-Dichloropropene	EPA 524.2	ug/L	<0.50	—
Trichloroethene	EPA 524.2	ug/L	<0.50	5
Trichlorofluoromethane	EPA 524.2	ug/L	<5	150
Trichlorotrifluoroethane	EPA 524.2	ug/L	<10	1,200
Trihalomethanes (total)	EPA 524.2	ug/L	<1.0	80
Vinyl Chloride	EPA 524.2	ug/L	<0.50	0.5
Xylenes (m+p)	EPA 524.2	ug/L	<0.50	—
Xylenes (ortho)	EPA 524.2	ug/L	<0.50	—
Xylenes (Total)	EPA 524.2	ug/L	<1.0	1,750

Table 4-5
Radiochemistry Water Quality Results

Constituent	Analytical Method	Units	Well B Groundwater (Sample from October 24, 2012)	California Drinking Water MCLs
Gross Alpha	EPA 908.0	pCi/L	14	15
Uranium	EPA 908.0	pCi/L	16	20

pCi/L = picocuries per liter

Table 4-6
Field Water Quality Parameters

Sample Date/Time	Temperature (°F)	pH	Conductivity (µS/cm)	TDS (mg/L)	Salinity (‰)	Turbidity (NTU)
10/22/2012 15:08	69.4	7.29	446	215	0.2	14.6

Water quality analyses indicate that all constituents sampled are below U.S. Environmental Protection Agency (EPA) and State of California MCLs. Inorganic constituents detected in water quality samples included aluminum, copper, fluoride, iron, manganese, nitrate reported as NO_3 and (as N), nitrate + nitrite (sum as nitrogen), and zinc. All detections were below the primary or secondary applicable MCLs, and most were several orders of magnitude below health-based thresholds. The only VOC detected was toluene (0.60 ug/L), which is unexpected given the depth of the well, the absence of any nearby sources of contamination, and the general groundwater characteristics. However, because the detection is several orders of magnitude below the respective MCL (150 ug/L), it is not considered to present a concern with respect to groundwater quality. Toluene may have been introduced into the well during drilling or pump installation as low levels of toluene have previously been linked to products used in splicing electrical wires. Periodic water quality sampling shall be conducted for Well B to ensure that toluene concentrations are declining or have stabilized. Elevated concentrations of gross alpha and uranium were also detected. These radionuclides are naturally occurring in bedrock aquifers in San Diego County. Radionuclides should be periodically monitored to ensure detections below MCLs.

4.3 Significance of Impacts Prior to Mitigation

Because all water quality constituents are below federal and California MCLs, the impact of the project with respect to groundwater quality is considered less than significant.

4.4 Mitigation Measures and Design Considerations

No mitigation measures are required or recommended because water quality constituents were all found to be below the applicable primary and secondary MCLs.

4.5 Conclusions

Water quality analyses indicate that all constituents sampled are below U.S. EPA and State of California MCLs, and the impact of the project with respect to groundwater quality would be less than significant under the California Environmental Quality Act.

5.0 SUMMARY OF PROJECT IMPACTS AND MITIGATION

As presented in Section 2.4, the peak construction water demands for the Project are estimated to range from 76,000–272,000 gpd to occur over a period of 50 to 60 working days. During this period, on-site Well B will be pumped at its maximum tested capacity of 61 gpm (88,000 gpd) up to 7 acre-feet over a 90 day period. Any deficit in water demand will be imported from permitted off-site sources. After Project grading is completed, construction water demand is estimated to range from 18,000 to 22,000 gpd for the purposes of daily dust control and concrete mixing. During Project operation, water demand will be limited to yearly application of soil binders, CPV panel washing, potable supply for the O&M building, and for the landscape vegetative screen. The annual operational water use is estimated to be 1.8 million gallons (approximately 6 afy). Six afy is equivalent to the quantity of water that on average is consumed by 12 households. As tested, Well B has sufficient capacity to meet all operational water demands of the Project.

The Project requests a one-time groundwater extraction of 18 acre-feet for construction and 6 afy thereafter for operation. The following presents a summary of the potential groundwater impacts evaluated for the Project including a discussion of reduction of groundwater storage, well interference, groundwater-dependent habitat, and water quality.

5.1 50% Reduction in Groundwater Storage

As presented in Section 3.1, a soil moisture balance analysis was performed to evaluate the impacts of the Project and the surrounding off-site users within 0.5-mile radius of Well B. The analysis indicates that the volume of groundwater in storage remains above the 50% significance threshold. Assuming a combined water demand of existing conditions, the Project, and full General Plan buildout, the minimum volume of groundwater in storage over the 30-year period analyzed was approximately 80% of the maximum groundwater storage capacity. The soil moisture balance analysis employed conservative values for precipitation, runoff, and evapotranspiration as discussed in Section 3.1. Additionally, the estimated groundwater storage of the resource study area employed a conservative saturated thickness of alluvium, residuum, and fractured rock of 1 foot, 5 feet, and 500 feet, respectively. These thicknesses underestimate the actual volume of groundwater in storage. As the Project will not exceed the 50% reduction in groundwater storage threshold and other cumulative groundwater demands will be met, groundwater impacts to storage will be less than significant.

5.2 Well Interference

As presented in Section 3.2, no drawdown was observed in any on-site or off-site wells during pumping at Well B. Fluctuations due to residential or irrigation pumping were observed in several off-site wells. In the wells that exhibit these expected changes in water level, fluctuations are observed over the entire monitoring period. All wells were monitored for over 1 month, spanning the period before, during, and after the pumping at Well B.

Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, drawdown due to 90 day peak construction water demand and over the entire 1 year Project construction period, at the nearest residential wells (RM-1 and RM-2) both located approximately 784 feet from Well B, is projected at 19.9 feet and 19.9 feet, respectively. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown at Wells RM-1 and RM-2 is projected at 14 feet (Table 3-11). Thus, well interference is not predicted to exceed the County threshold of significance of a decrease in water level of 20 feet or more in the off-site wells after a 5-year projection of drawdown (County of San Diego 2007). Additionally, off-site well interference is not predicted to be an impact for the Project based on Well B short-term 90 day peak construction pumping rates or over the entire 1 year construction period.

5.3 Groundwater Dependent Habitat

As presented in Section 3.2.1.2, there are two vegetation habitats identified in the Project vicinity that may potentially depend on groundwater. These vegetation types include coast live oak woodland and open water. Coast live oak is a native drought-resistant evergreen tree with a root system that consists of a deep taproot with several main roots that may tap groundwater if present within approximately 36 feet of the soil surface. The open water includes mixed predominantly grass species that are reliant on surface water or perched groundwater that is within a few feet of the ground surface. As no drawdown was observed in on-site shallow wells (Wells 1, 4, and 5) or in the nearest off-site shallow wells (Wells RM-2 and RM-3), there appears to be limited hydraulic connection between primary producing fractures of the pumping well (Well B) at greater than 1,000 feet bgs and the shallow aquifer system. Given the limited duration of the 72 hour constant rate test it is uncertain whether there is hydraulic isolation of the shallow alluvial aquifer associated with Rattlesnake Creek from the deep fractured bedrock aquifer.

As projected by the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, the maximum expected drawdown at Well RM-3 (located within area identified with groundwater dependent habitat) is 18.3 feet during the approximate 1 year Project construction period. Therefore, Project well production may exceed the County threshold of significance for

groundwater dependent habitat: drawdown of the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historical low groundwater levels. However, as the historical low groundwater levels in the vicinity of the Project site are unknown, it is uncertain if this threshold would be exceeded.

5.4 Water Quality

As presented in Section 4.0, water quality analyses of Well B indicate that all constituents sampled are below U.S. EPA and State of California MCLs; therefore, groundwater impacts from water quality would be less than significant.

5.5 Mitigation Measures

As the analysis contained herein is based on limited production well testing, monitoring will be conducted to ensure that County well interference thresholds are not exceeded. A GMMP has been prepared for the Project (Dudek 2013), which details establishment of groundwater thresholds for off-site well interface and groundwater dependent habitat.

Well Interference: A network of on-site and off-site wells has been established to monitor water levels. Pressure transducers will remain in select on-site and off-site wells to record water level fluctuations. Off-site Wells RM-1, RM-3 and RSD-1 located within half-mile radius of Well B have been fitted with 1-inch sounding tubes and pressure transducers to record water levels. Manual water level measurements will be recorded with a sounder to confirm transducer accuracy. Baseline water level conditions in RM-1, RM-3 and RSD-1 have been established through water level measurements recorded by the pressure transducers since October 2012. During pumping at Well B, a maximum drawdown of 10 feet below the previously established water level baseline will be allowed for off-site wells.

Based on the theoretical well interference analysis using the Copper-Jacob approximation of the Theis non-equilibrium flow equation, the maximum amount of groundwater that can be pumped during the 1 year construction period without resulting in significant well interference impacts on the closest well user to Well B is 18 acre-feet. Therefore, a production cap of 7 acre-feet during the first 90 days of construction and 18 acre-feet over the approximate 1 year construction period is required by the County for Well B.

Groundwater dependent habitat: Existing off-site monitoring wells RM-1 and RM-3 are located within the coast live oak and mixed oak woodland and the wells are reported to be partially completed within the alluvial aquifer. The historical low groundwater level in the vicinity of the oak woodland is not known over the period corresponding to the lifespan of mature oaks. This lack of historic water level data precludes determination of a water level threshold 3 feet below the

historical low. Therefore, routine biological monitoring of the oak woodland for the duration of the 1 year Project construction period will serve as a means to continually assess oak health. Biological monitoring procedures are described in the GMMP. If an ISA Certified Arborist or Registered Profession Forester observes that no impact to the oak woodland has occurred over the construction period, biological monitoring of the oak woodland will cease. In addition to biological monitoring a water level threshold of 10 feet of drawdown below baseline at RM-1 and RM-3 will be established to protect the oaks' ability to continually access groundwater from the alluvial aquifer.

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7.0 LIST OF PREPARERS AND PERSONS AND ORGANIZATIONS CONTACTED

This report was prepared by Dudek Hydrogeologists Trey Driscoll, PG, CHG; Patrick Rentz; Dylan Duvergé; and Steve Stuart, PE. Dudek Hydrogeologist Stephen K. Dickey, PG, CHG, CEG, provided review assistance and coordination with the County as the County-approved hydrogeologist. Peter Quinlan, RG and principal-in-charge; and Jill Weinberger, PhD, PG, provided peer review of this report. Fieldwork was conducted by the above hydrogeologists and Kayvan Ilkhanipour, PG, CHG; Peter Hoseit; and Rachel Ganiere. Graphics and GIS mapping and analyses were provided by Patrick Rentz and Dylan Duvergé. This report was prepared in coordination with County Groundwater Geologist James Bennett, with meteorological input from Rand Allan from the San Diego County Flood Control.

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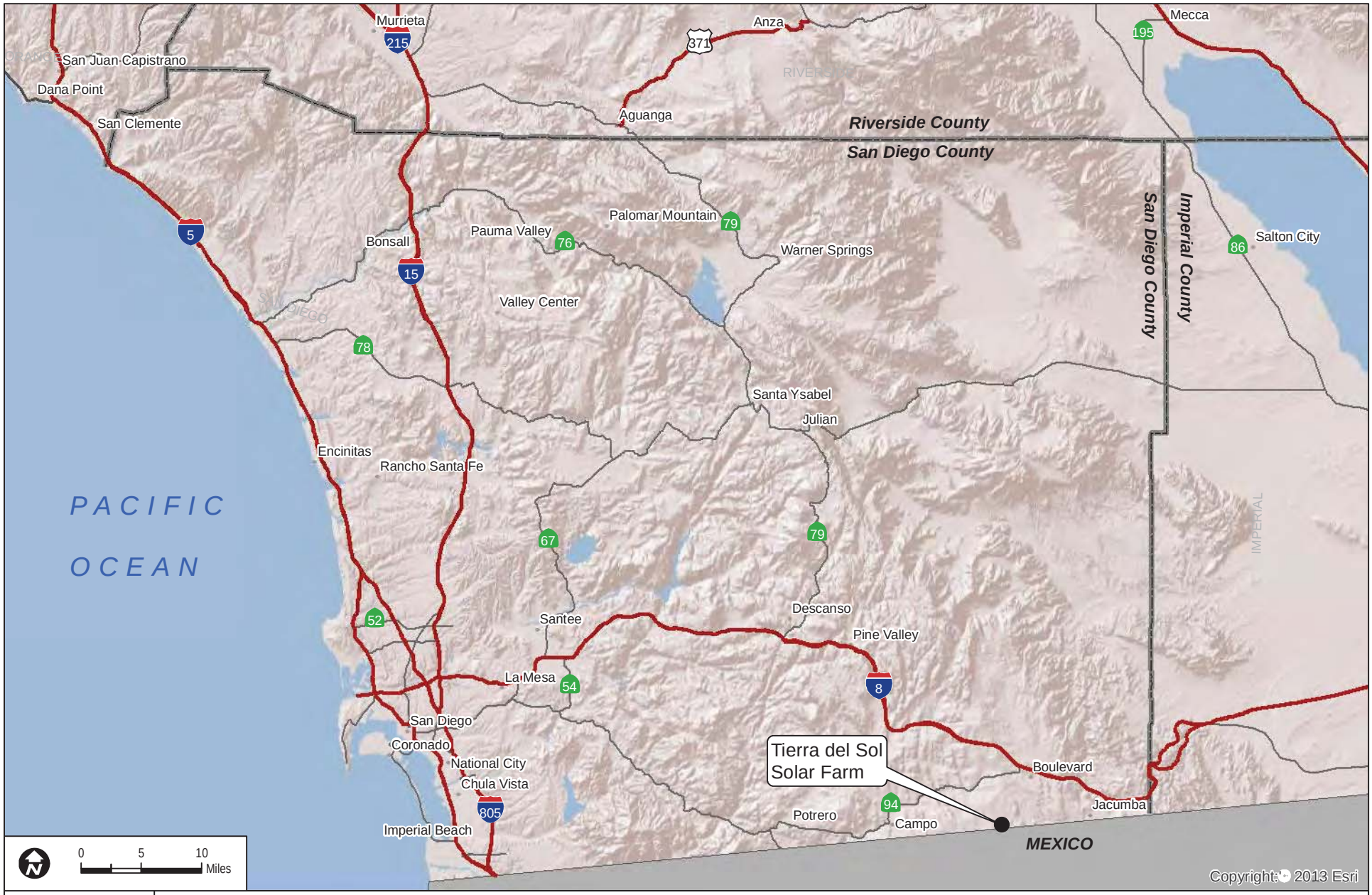

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FIGURE 1

Regional Location

GROUNDWATER RESOURCES INVESTIGATION REPORT - TIERRA DEL SOL SOLAR FARM

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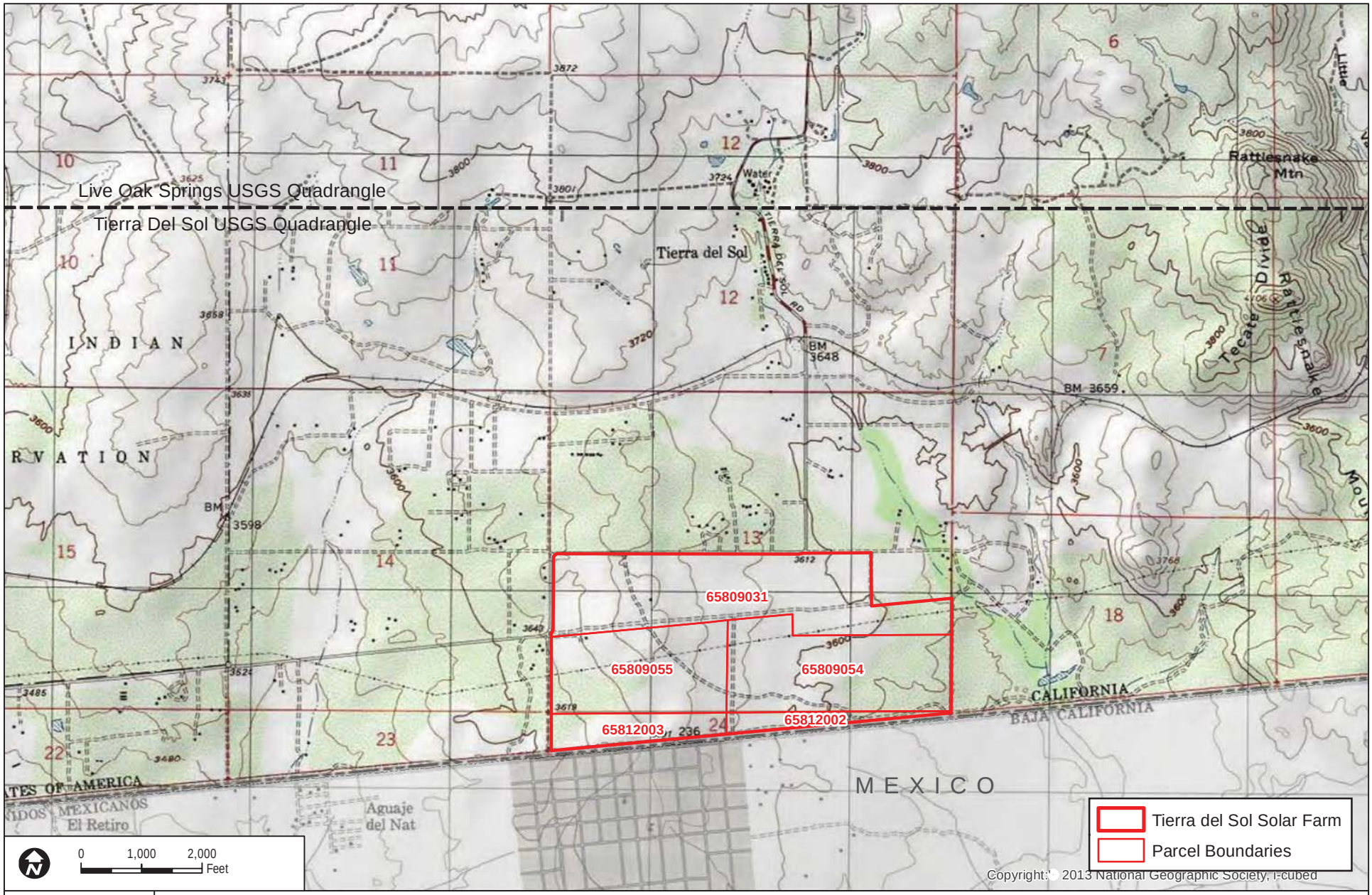

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SOURCE: SanGIS 2012; Bing Maps

FIGURE 2

Vicinity Map

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GROUNDWATER RESOURCES INVESTIGATION REPORT - TIERRA DEL SOL SOLAR FARM

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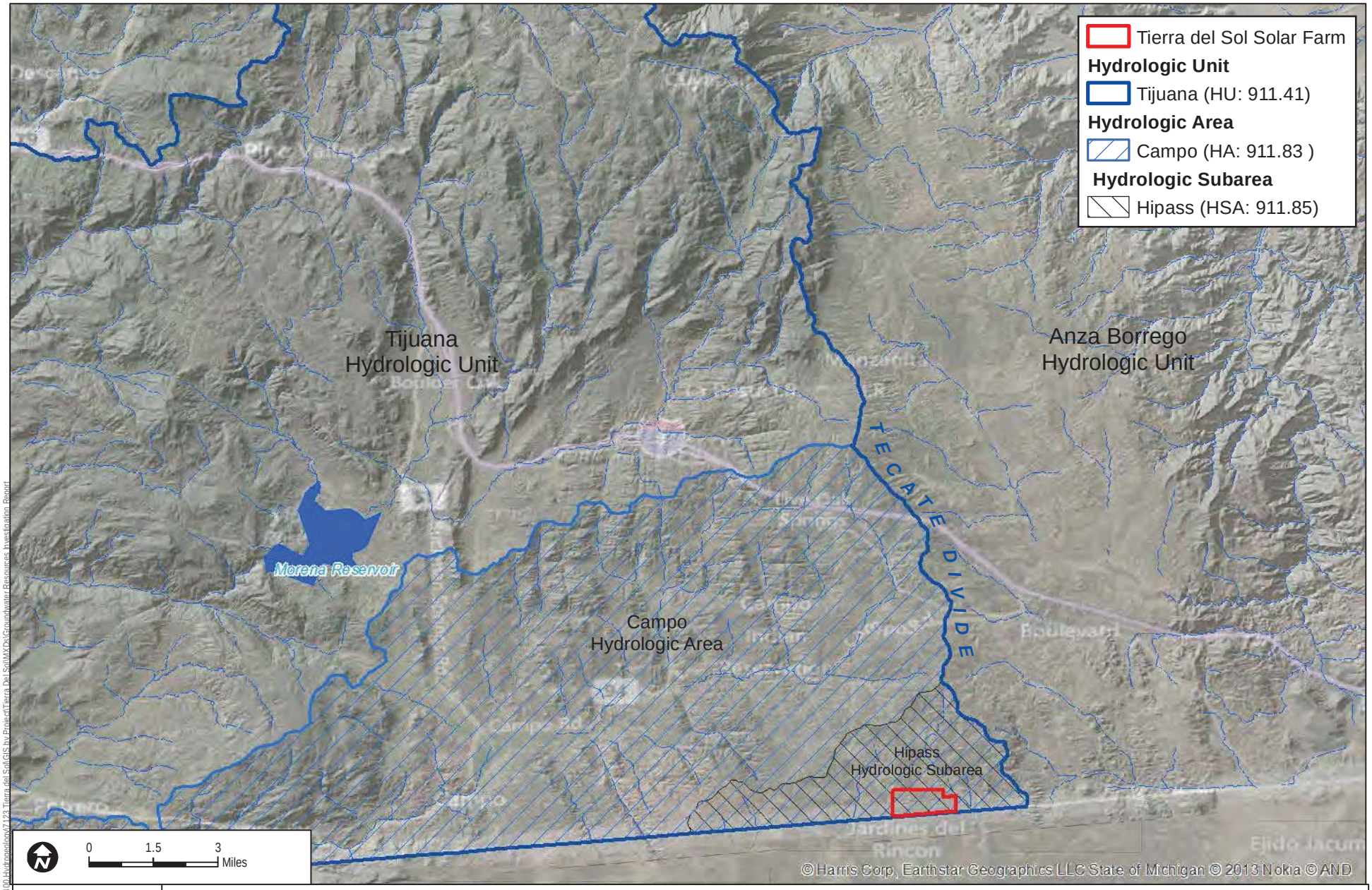

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SOURCE: U.S. Geological Survery National Hydrography Dataset (USGS 2012)

FIGURE 3

Hydrologic Areas

GROUNDWATER RESOURCES INVESTIGATION REPORT - TIERRA DEL SOL SOLAR FARM

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