FINAL

Groundwater Resources Investigation Report
Jacumba Community Services District
Jacumba Hot Springs, San Diego County, California

Lead Agency:

County of San Diego
Planning and Development Services
5510 Overland Avenue
San Diego, California 92123
Contact: Ashley Gungle

Project Proponent:

Tierra del Sol Solar Farm LLC and Rugged Solar Farm LLC
c/o Soitec Development LLC
16550 Via Esprillo
San Diego, California 92127
Contact: Dwain Boettcher, Soitec Solar, Inc.

Prepared by:

DUDEK
605 Third Street
Encinitas, California 92024

Stephen K. Dickey, PG, CHG, CEG

DECEMBER 2013

Printed on 30% post-consumer recycled material.

TABLE OF CONTENTS

Section **Page No.**

TABLE OF CONTENTS (CONTINUED)

Section **Page No.**

APPENDICES

EXHIBITS

TABLE OF CONTENTS (CONTINUED)

Page No.

FIGURES

TABLES

INTENTIONALLY LEFT BLANK

GLOSSARY OF TERMS AND ACRONYM

afy	Acre-Feet per Year
amsl	Above Mean Sea Level
APN	Assessor's Parcel Number
bgs	below ground surface
btoc	below top of casing
CDPH	California Department of Public Health
CIMIS	California Irrigation Management Information System
CN	Curve Number
CNM	Curve Number Method
County	County of San Diego
CPV	Concentrator Photovoltaic
DG	decomposed granite
DPLU	Department of Planning and Land Use
DWR	Department of Water Resources
ET	Evapotranspiration
EPA	Environmental Protection Agency
FWS	U.S. Fish and Wildlife Services
GMMP	Groundwater Monitoring and Mitigation Plan
gpd	gallons per day
gpd/ft	gallons per day/foot
gpm	gallons per minute
HSA	Hydrologic Subarea
IFSAR	Interferometric Synthetic Aperture Radar
MCL	Maximum Contaminant Level
mg/L	Milligrams per Liter
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resource Conservation Service
NWS	National Weather Service
P	Precipitation
PDS	Planning and Development Services
Q	Runoff
RL	Rural Lands
RWQCB	Regional Water Quality Control Board
S	Soil Moisture Retention
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
VR	Village Residential

EXECUTIVE SUMMARY

In accordance with San Diego County Planning guidance, Dudek has prepared this groundwater resources investigation report to examine the potential impact of purchasing water from the JCSD on groundwater resources within Jacumba Hot Springs, California. The water purchased from JCSD would be used to supplement non-potable water required during construction of the proposed Tierra del Sol and Rugged Solar Farm Projects (the Projects).

The Rugged Project is expected to require approximately 16 acre-feet of off-site water during the first 65 days of construction when Rugged's on-site wells cannot meet the peak water demands required for site grading.

The Tierra del Sol Project is anticipated to require approximately 32 acre-feet of off-site water during the first two months of construction when the on-site well cannot meet the peak water demands required for grading.

Several off-site water sources including JCSD Well 6 have been identified to meet the construction water demands of the Projects. The JCSD has a dedicated non-potable Well 6 for off-site construction water supply use. Groundwater pumped from Well 6 will be supplied at the discretion of the JCSD and has been historically limited to a production cap of up to 80,000 gallons per day (gpd). Based on historical production for off-site uses from Well 6 when limited to 80,000 gpd, no deleterious impacts have been observed to groundwater storage or well interference.

This analysis addresses potential impacts on JCSD groundwater resources based on the Projects obtaining all the required off-site groundwater supply from Well 6 to simulate a worst-case scenario. The significant results of the groundwater resource investigation report are as follows:

- JCSD intends to make up to 80,000 gpd available for Project use from Well 6. This is approximately 9.3% of the tested production capacity of Well 6. JCSD will monitor water levels in nearby wells to verify that producing 80,000 gpd from Well 6 does not adversely impact the surrounding aquifer.
- The short-term water demand from Well 6 for the Rugged Solar Farm construction is expected to be up to 5.2 million gallons, or 16 acre-feet over an approximate 65 day period (i.e. 80,000 gpd x 65 days = 5.2 million gallons).
- The peak construction water demand for Tierra del Sol is anticipated to be approximately 32 acre-feet during the first 60 days of bulk grading. At a production rate of 80,000 gpd, JCSD Well 6 can supply 46% of the required 174,000 gpd. To make a conservative impact assessment, this analysis assumes that the entire 32 acre-foot construction water requirement will be obtained from Well 6 in 130 days at a rate of 80,000 gpd, without use of additional off-site water supply sources.

- The groundwater storage in the aquifer underlying the Boundary Creek watershed has a total of 5,495 acre-feet of storage.
- Approximately 19.5% of the contributing watershed (2,385 acres) is located in Mexico and was not evaluated or included in this analysis.
- The water budget analysis indicates that the amount of groundwater storage would not be reduced to a level of 50% or less as a result of additional pumping for off-site construction water supply.
- The transmissivity estimated for Well 6 is 810 feet^2/day or 6,060 gallons per day/foot (gpd/ft) using the Cooper-Jacob approximation of the Theis non-equilibrium flow equation. This result is utilized to calculate drawdown impacts.
- The water level drawdown at nearby Well 4 is estimated at 0.83 feet over the period of groundwater supply for the Projects. Thus, well interference impacts to the alluvial aquifer would be less than significant based on County of San Diego well interference threshold guidance for alluvial wells.
- The water level drawdown in Well 6 as a result of groundwater production for the Projects and 15 million gallons of production for the East County Substation Project is estimated at 4.8 feet. Thus, well interference impacts to the fractured rock aquifer would be less than significant based on County of San Diego well interference threshold guidance for fractured rock wells.
- The estimated drawdown at the nearest groundwater dependent habitat as a result of groundwater production for the Projects is estimated at approximately 0.83 feet and would not exceed the historical low water level recorded in Well 4 of approximately 23 feet below ground surface (bgs). Thus, impacts to groundwater dependent habitat would be less than significant.
- Water quality analyses of Well 6 indicate elevated fluoride, temperature, and trace sulfide. This water quality is acceptable for construction use. As water supplied from Well 6 is only intended for construction use, impacts due to the use of non-potable water would be less than significant.

A separate Groundwater Monitoring and Mitigation Plan (GMMP) has been prepared for the proposed groundwater extraction from Well 6, which details thresholds for off-site well interference and groundwater dependent habitat. The GMMP will provide recommendations for ongoing water level monitoring and establish groundwater thresholds for off-site well interference and groundwater dependent habitat.

1.0 INTRODUCTION

1.1 Purpose of the Report

This groundwater resources investigation was prepared on behalf of Soitec 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 groundwater resource investigation is being provided to evaluate the use of up to 48 acre-feet of groundwater from Jacumba Community Services District Well 6. The results contained herewith should not be relied upon for use of any other groundwater proposal subject to County review in Jacumba Hot Springs, California.

1.2 Project Location

The JCSD is located in Jacumba Hot Springs on the international border with Mexico in southeastern San Diego County, California (Figures 1 and 2). JCSD operates several water supply wells that serve approximately 561 residents or 294 total housing units (US Census 2010). In addition, several commercial entities are supplied by the JCSD.

1.3 Project Description

For off-site water supply, JCSD intends to supply water from Well 6 located at the west end of downtown Jacumba Hot Springs on assessor's parcel number (APN) 660-040-32 (Figures 2 and 11). JCSD will make up to a monthly maximum production rate of 2.48 million gallons (7.6 acre-feet) available from Well 6. This equates to an average daily production rate of 80,000 gpd. The JCSD has at its discretion set the production rate of Well 6 at 9.3% of the tested production capacity of the well of 600 gpm (864,000 gpd). JCSD has indicated that water supply from Well 6 is contingent upon nearby groundwater levels remaining stable.

Access to Well 6 would be from Old Highway 80 onto a gravel road approximately 350 feet long by 15 feet wide. Water will be extracted from the well using an existing submersible pump and discharged to a 12,000 gallon water tower. It is estimated that either 14 trucks per day capable of hauling 6,000 gallons of water or 20 trucks per day capable of hauling 4,000 gallons of water would haul up to 80,000 gpd from Well 6. The water would be transported west on Old Highway 80 to the Tierra del Sol Solar Farm and Rugged Solar Farm sites located approximately 14 miles and 9 miles, respectively from Well 6.

1.4 Applicable Groundwater Regulations

The County Guidelines for Determining Significance—Groundwater Resources contain a series of thresholds for determining significance for both groundwater quantity and groundwater quality. To evaluate impacts to groundwater resources, a water balance analysis is typically required. 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:

> *Fractured Rock Well*: 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).

> *Alluvial Well*: 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 5 feet or more in the off-site wells. If site-specific data indicates alluvium or sedimentary rocks exist which substantiate a saturated thickness greater than 100 feet in off-site wells, a decrease in saturated thickness of 5% or more in the off-site wells 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 Maximum Contaminant Levels

> (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.

To evaluate groundwater impacts to groundwater dependent habitat as a result of this project, the following guideline for determining significance is typically used:

> 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 (County of San Diego 2010a).[1]

The JCSD is a Water Service Agency regulated by the California Department of Public Health's (CDPH) Drinking Water Program (DWP). Thus, JCSD is not subject to the County's Groundwater Ordinance (County of San Diego 2013).

[1] Studies have found that groundwater reductions adversely affect native plant species. Two of the referenced studies (Integrated Urban Forestry, 2001 and National Research Council, 2002) found that permanent reduction in groundwater elevation levels of greater than three feet is enough to induce water stress in some riparian trees, particularly willow (*Salix* spp.), cottonwood (*Populus* spp.) and *Baccharis* species.

INTENTIONALLY LEFT BLANK

2.0 EXISTING CONDITIONS

2.1 Topographic Setting

Jacumba Hot Springs is located in southeastern corner of San Diego County and is bordered by Imperial County to the west and Mexico to the south (Figures 1 and 2). The Jacumba Valley watershed covers a 119 square mile area with 70% of the watershed located in the state of Baja California, Mexico (Swenson 1981). The United States side of the watershed is located within the Jacumba Valley Hydrologic Subarea (HSA; 722.72), all within the Anza Borrego Hydrologic Unit (HU; 722.00) that drains toward the Salton Sea (Figure 3). The Jacumba Valley drains through a narrow constriction north of Jacumba Hot Springs known as the Carizzo Gorge. Jacumba Hot Springs is located at an approximate elevation of 2,829 feet above mean sea level (amsl).

JCSD Well 6 is located north of Old Highway 80 and south of Boundary Creek at an approximate elevation of 2,844 feet amsl (Figure 2). At this elevation, Well 6 is situated above the Jacumba Valley floor. The precipitation runoff that recharges Well 6 falls within the Boundary Creek watershed, which is tributary to Jacumba Valley (Figure 10). The Boundary Creek watershed consists of approximately 12,239 acres with 19.5% of the watershed located in Mexico. The Boundary Creek watershed ranges from 4,020 feet amsl and its headwaters along the Tecate divide to 2,848 feet amsl at Well 6.

2.2 Climate

Jacumba 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-80s to high-60s (degrees Fahrenheit) in the fall months. Temperatures may fall below freezing in the winter, with snow levels occasionally below 2,500 feet.

Monthly precipitation records were obtained from the County of San Diego for a rain gauge previously located in Jacumba at 32°37' North latitude, 116°11' West longitude, and an elevation of 2,800 feet. The period of record available is from March 1963 until March 2011. Table 2-1 provides average monthly precipitation data, and highest/lowest monthly precipitation for the Jacumba rain gauge.

Table 2-1
Precipitation Data Recorded at Jacumba Rain Gauge

Month	Rainfall (inches) – 1963–2011		
	Average	*Highest/ Year*	*Lowest*
Jan.	1.45	5.79/ 1983	0
Feb.	1.66	10.86/ 1993	0

Table 2-1
Precipitation Data Recorded at Jacumba Rain Gauge

Month	Rainfall (inches) – 1963–2011		
	Average	*Highest/ Year*	*Lowest*
Mar.	1.82	6.76/ 1998	0
Apr.	1.45	7.13/ 1991	0
May	0.50	2.38/ 1965	0
June	0.19	2.24/ 1981	0
July	0.06	0.96/ 1984	0
Aug.	0.45	3.97/ 1984	0
Sep.	0.50	3.48/ 1992	0
Oct.	0.37	4.58/ 1976	0
Nov.	0.60	4.37/ 2004	0
Dec.	0.85	3.82/ 1965	0
Year	9.64	22.16/ 1982-83	2.26

Notes: Jacumba rain gauge located at N 32°37', W 116°11', at an elevation of 2,800 feet.
Source: Allan, R. B., 2013.

According to historical precipitation data recorded from 1963 to 2011 from the Jacumba rain gauge, the average annual precipitation is approximately 9.64 inches per year with 85% of precipitation occurring between October and April. Annual precipitation totals at the Jacumba rain gauge varies significantly from year to year as depicted below in Exhibit 2-A.

Precipitation records from six nearby rain gauges were obtained in order to determine annual average rainfall within the Boundary Creek watershed. The rain gauges are located in Boulevard (two stations), Tierra del Sol, Morning Star Ranch, Campo and Jacumba. 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
Jacumba	N 32°37', W 116°11'	2,800	1963 to 2011	9.64	County

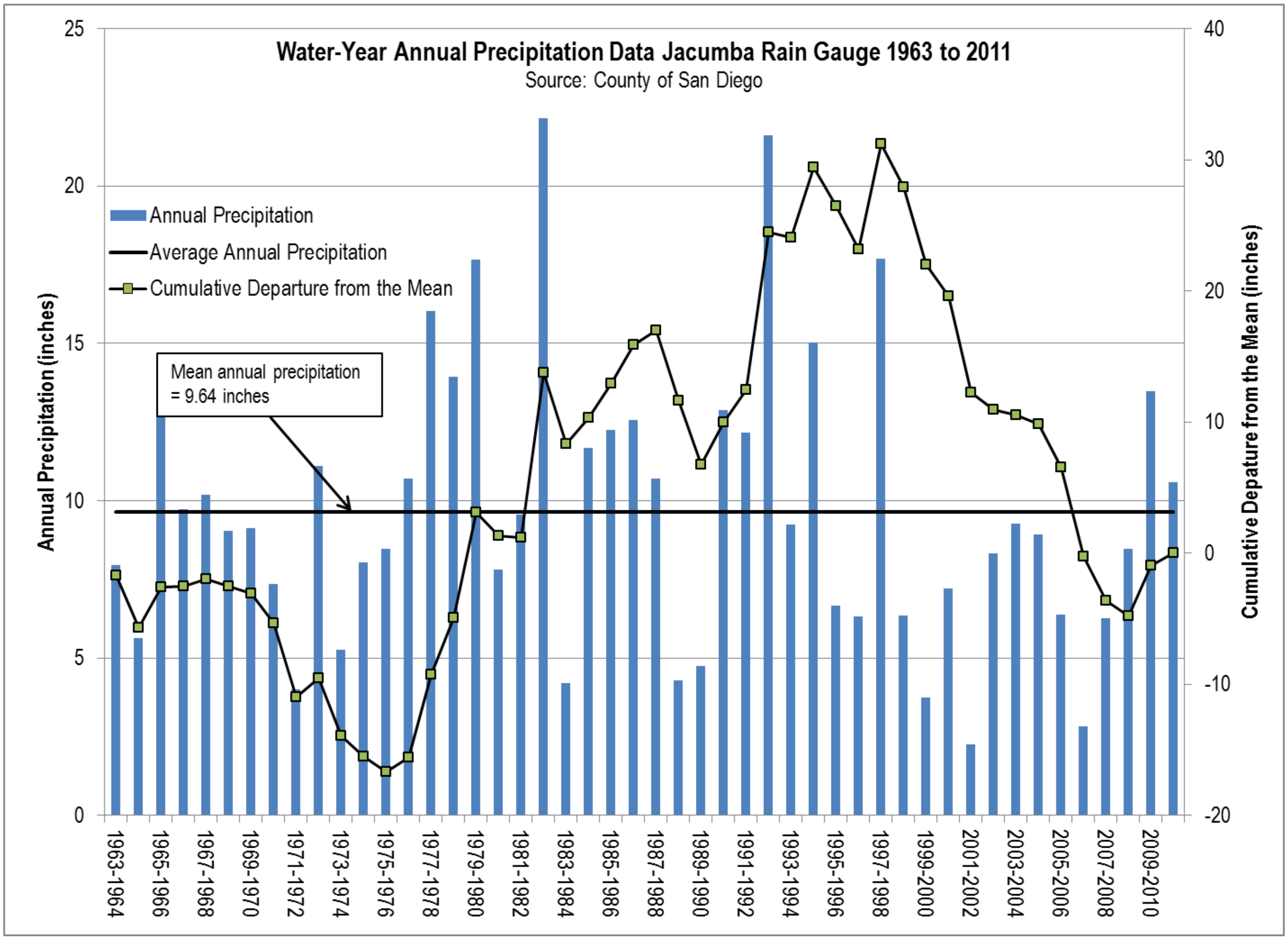
As the Jacumba rain gauge is located at the lowest elevation in the Boundary Creek watershed, it is not representative of precipitation falling at higher elevation. According to the USGS isohyetal map, annual precipitation over the majority of the Boundary Creek watershed is greater than that of Jacumba, averaging 14 inches per year (Figure 4). Mean annual precipitation, as determined from the County of San Diego map entitled "Groundwater Limitations Map" on file with the Clerk of the Board of Supervisors as Document No. 195172, indicates that the Boundary Creek watershed is almost entirely located within a precipitation isohyetal of 12 to 15 inches with a small portion of the watershed located in a precipitation isohyetal of 15 to 18 inches (County of San Diego 2004).

The Tierra del Sol monitoring station located at 32°39' North latitude, 116°19' West longitude, and an elevation of 4,000 feet is situated along the ridgeline atop the Tecate divide along the western boundary of the Boundary Creek watershed (Figure 4). Using the precipitation data available from 1971 to 2012 for the Tierra del Sol rain gauge, average annual precipitation is approximately 10.95 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-D). Precipitation measured at Campo Station located at 32°37' North latitude, 116°28' West longitude, and an elevation of 2,630 feet from 1982 to 2011 indicates an average annual precipitation of 15.2 inches (Exhibit 2-C). For the period from 1982 to 2012, the average annual precipitation at Campo is 15.39 inches as compared to only 11.3 inches at Tierra del Sol over the same 30-year period. Precipitation data measured at the Morning Star Ranch from 1990 to 2005 (Ponce 2006), located 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 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 (thunder storms) 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 at Campo is a 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).

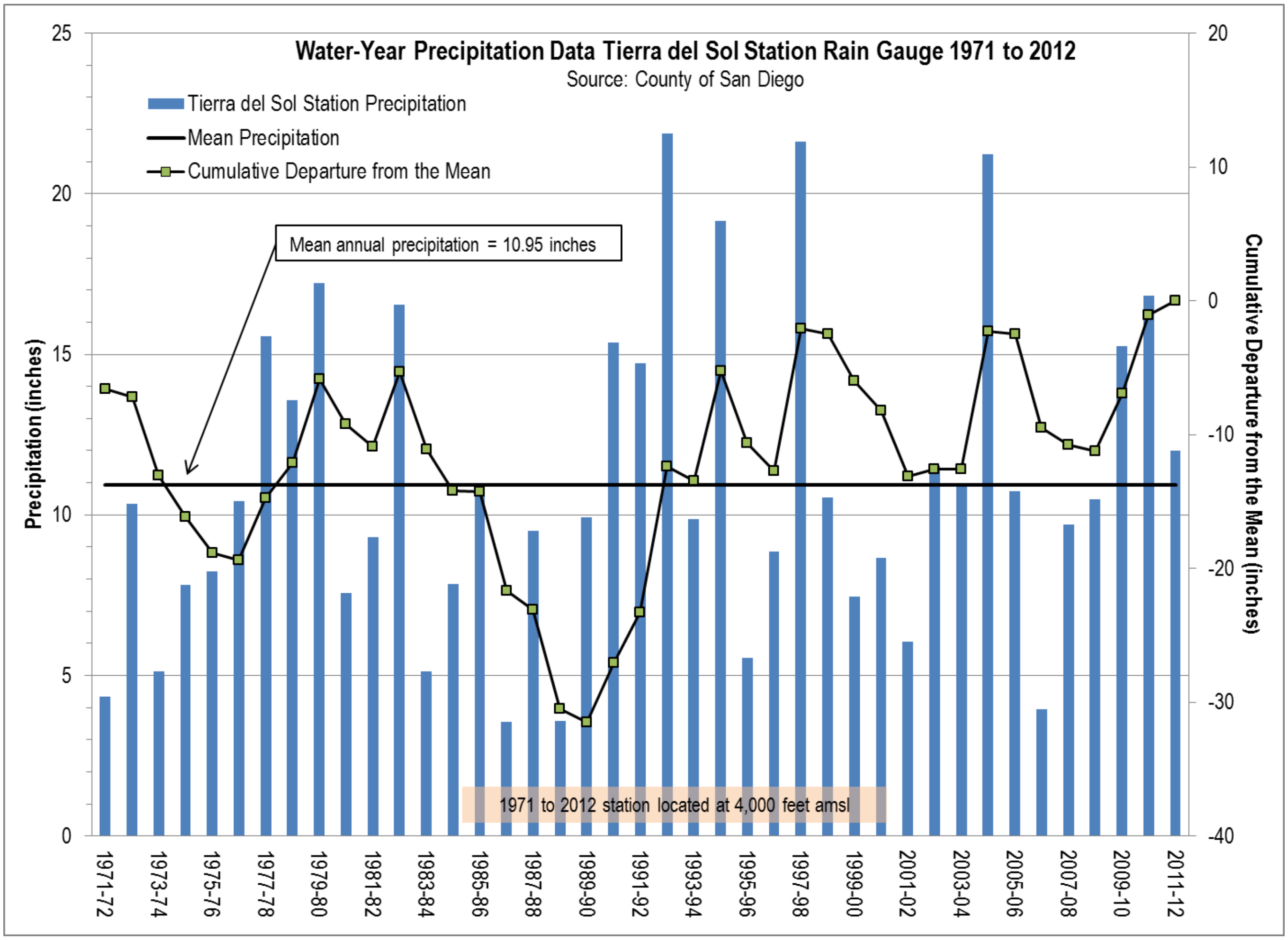
Based on review of local rainfall data in the Project area, it appears that the Tierra del Sol rain gauge underestimated rainfall by 20% to 27% during the last 30-year period. Therefore, the water balance analysis presented in Section 3 that uses the Tierra del Sol precipitation data likely underestimates precipitation and groundwater recharge to the Boundary Creek watershed. 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 (see Section 3.1.3; Exhibits 3A, 3B and 3C).

Exhibit 2-A
Annual Precipitation Data Jacumba Rain Gauge 1963 to 2011



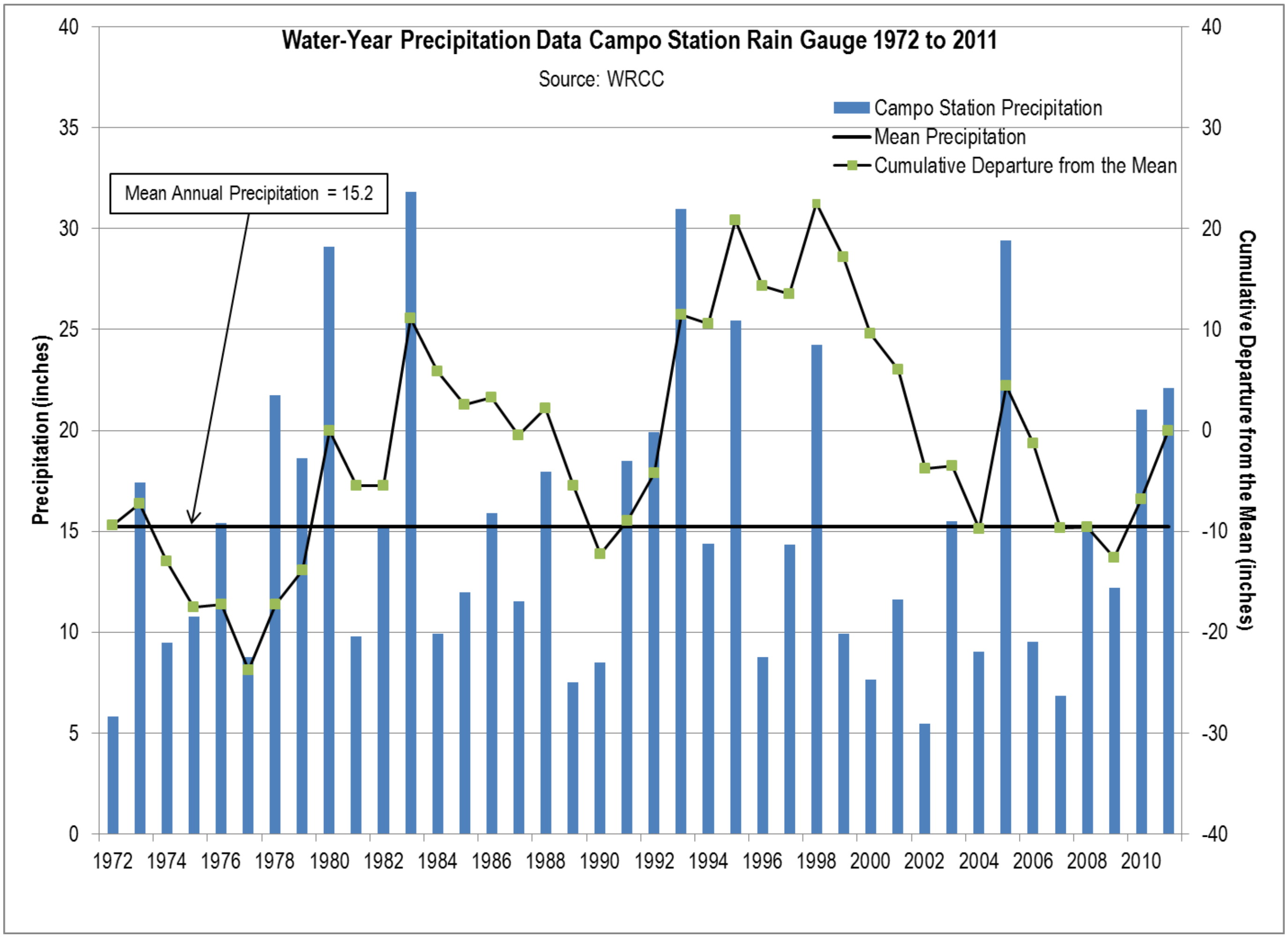
Notes: Station located at N 32°37', W 116°11' at an elevation of 2,800 feet

Exhibit 2-B
Annual Precipitation Data Tierra del Sol Rain Gauge 1971 to 2012



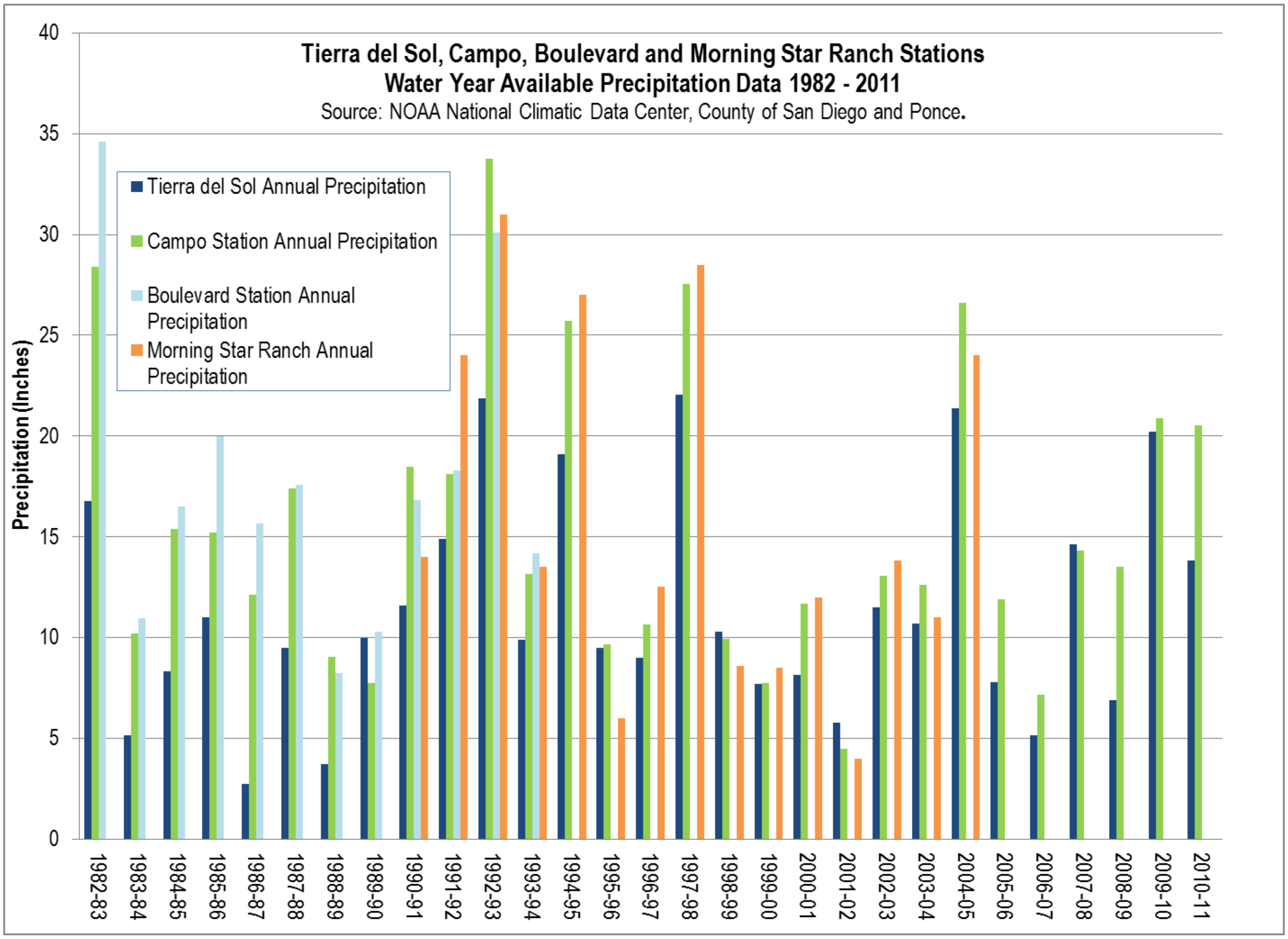
Notes: Station located at N 32°39', W 116°19' at an elevation of 4,000 feet

Exhibit 2-C
Annual Precipitation Data Campo Rain Gauge 1972 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 2-3 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 2-3
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

According to the San Diego General Plan, Jacumba Hot Springs is located within the Mountain Empire Subregional Plan Area (County of San Diego 2011). Land Use designations within 0.5 mile radius of Well 6 includes, open space, public facilities, rural commercial, rural lands, semi-rural residential, specific plan area, and village residential (Figure 5). The parcel on which Well 6 is located is zoned as semi-rural residential (SR-1). The JCSD holds the fee interest to the well site with an appurtenance express easement, which was relocated from its original location by the property parties (JCSD 2010). Adjacent current land uses are vacant land, commercial businesses along Old Highway 80 and residences.

Current land use within the Boundary Creek watershed consists primarily of vacant, undeveloped land with a smaller portion of land used for field crops and open space for parks or preserves (Figure 10). According to the San Diego General Plan (San Diego County 2011) the land outside Jacumba Hot Springs within the Boundary Creek watershed is predominantly zoned rural lands (RL-80 and RL-40), with small percentage of semi-rural lands (SR-10) and public agency lands.

2.4 Water Demand

Off-site supply of 80,000 gpd from Well 6 was analyzed over a continuous pumping period of 196 days to simulate a worst case scenario of water level decline. This would result in extraction of 15.7 million gallons (48 acre-feet) over the 196 day period. The short-term water demand from Well 6 for the Rugged Solar Farm construction is expected to be up to 5.2 million gallons, or 16 acre-feet over an approximate 65 day period (i.e. 80,000 gpd x 65 days = 5.2 million gallons). The short-term water demand from Well 6 for the Tierra del Sol Solar Farm construction is expected to be up to 10.4 million gallons, or 32 acre-feet over an approximate 130 day period (i.e. 80,000 gpd x 130 days = 10.4 million gallons). As Tierra del Sol grading is currently planned to occur over 60 working days, water would likely need to be imported from other sources in addition to the JCSD to meet peak water demands. Nonetheless, this analysis assumes all off-site water would be supplied from JCSD to simulate a worst-case scenario.

The JCSD served 30 million gallons (92.1 acre-feet) of water from Well 4 over the period of January through November 2013 to meet the water demands of the potable water system. (Troutt pers. comm. 2013). Additionally, JCSD has been supplying water from Well 6 for construction use at the East County (ECO) Substation Project since April 2013. Through November 2013, JCSD had supplied 9.6 million gallons (29.5 acre-feet) to the San Diego Gas and Electric (SDG&E) ECO Substation Project. JCSD has an agreement with SDG&E to sell up to 15 million gallons (46 acre-feet) of water from Well 6 to meet construction water demands. Table 2-4 provides JCSD monthly water production by well.

Table 2-4
JCSD 2013 Water Production by Well

Month	JCSD Well 4 Production (gallons)	JCSD Well 6 Production (gallons)	Total JSCD Supply from Boundary Creek Watershed
January	30 million gallons (92.1 acre-feet) pumped from January through November	0	
February		0	
March		549,210	
April		0	
May		893,112	
June		1,594,099	
July		1,946,360	

Table 2-4
JCSD 2013 Water Production by Well

Month	JCSD Well 4 Production (gallons)	JCSD Well 6 Production (gallons)	Total JSCD Supply from Boundary Creek Watershed
August		2,343,718	
September		1,466,509	
October		358,292	
November		454,792[a]	
December			
Total gallons (to date)	30,000,000	9,606,092	39,606,092
Total acre-feet (to date)	92.07	29.48	121.55

Source: JCSD 2013
Notes:
a. Includes water demand for U.S. Border Patrol

2.5 Geology and Soils

Jacumba is located on the eastern portion of the Peninsular Range geomorphic province, which consists of northwest-oriented mountain ranges separated by northwest trending fault-produced valleys, subparallel to faults branching from the San Andreas Fault. The regional geology of this area is depicted in Figure 6. The majority of the valleys are filled with Quaternary alluvium, however, the Jacumba Valley contains Tertiary sedimentary and volcanic formations as well (Swenson 1981). Alluvial thickness in the center of Jacumba Valley is 100 to 150 feet, thinning towards the sides and ends of the valley (Swenson 1981). Metamorphic rocks composed of migmatitic schist and gneiss of the Stephenson Peak formation outcrop just west of the valley (Swenson 1981, USGS 2004). Cretaceous plutonic rocks including the Indian Hill granodiorite of Parrish are present to the north of the valley (USGS 2004). The Tertiary Jacumba Volcanics are exposed within the valley (USGS 2004). These volcanic rocks are comprised of basaltic and andesitic pyroclastics and lava flows (Swenson 1981).

The surface area of the Boundary Creek watershed primarily consists of exposed Cretaceous plutonic rocks of the composite Peninsular Ranges Batholith. These plutonic rocks consist of the bedrock unit known as the tonalite of La Posta (also referred to as the La Posta Quartz Diorite) (USGS 2004). The Stephenson Peak metamorphic rocks outcrop in over much of southeastern portion of the watershed. The Jacumba Volcanics are also exposed over a relatively small area in the southeastern part of the watershed. Quaternary alluvium is present in low lying areas in portions of the watershed (USGS 2004).

The soils in a watershed play an important role in the hydrologic cycle. A soil's permeability, specific retention and active rooting depth are controlling factors that determine what portion of the precipitation runoff satisfies the soil moisture requirements and recharges groundwater. The type, aerial extent, and some key physical and hydrological characteristics of soils mapped in the

Boundary Creek watershed were identified based on a review of soil surveys completed by the USDA, Natural Resources Conservation Service (NRCS) (NRCS 2013). Soil units are shown in Figure 7 and are described in Table 2-5.

Table 2-5
Soil Units within the Boundary Creek watershed

Map Unit, Soil Name	Acres (Percent of the Project Site)	Parent Material	Depth to restrictive layer (inches)	Hydrologic Group[a]	Erosion Factor [b]
AcG, Acid Igneous Rock Land	1,067 (11%)	Acid igneous rock	0–4	D	—
CaB, Calpine Coarse Sandy Loam, , 2-5% slope	14 (0.1%)	Alluvium derived from granite	> 60	B	0.15-0.24
CaC, Calpine Coarse Sandy Loam, 5-9% slope	15 (0.2%)	Alluvium derived from granite		B	
CaD2, Calpine Coarse Sandy Loam, 9-15% slope	37 (0.4%)	Alluvium derived from granite		B	
CeC, Carrizo Very Gravelly Sand, 0-9% slope	176 (2%)	Alluvium derived from mixed igneous rocks		D	
LaE2, La Posta Loamy Coarse Sand, 5-30% slope	1,844 (19%)	Residuum weathered from granodiorite		A	
LcE2, La Posta Rocky Loamy Coarse Sand, 5-30% slope	1,531 (16%)	Residuum weathered from granodiorite	20–40	A	0.15–0.24
LdE, La Posta-Sheephead Complex, 9-30% slope	876 (9%)	Residuum weathered from granodiorite		A or C	
LdG, La Posta-Sheephead Complex, 30-65% slope	255 (3%)	Residuum weathered from granodiorite		A or C	
Lu, Loamy Alluvial Land	17 (0.2%)	Residuum weathered from calcareous sandstone and shale	> 60	B	0.37–0.49
MvD, Mottsville Loamy Coarse Sand, 9-15% slope	66 (0.7%)	Alluvium derived from granite		A	
MvC, Mottsville Loamy Coarse Sand, 2-9% slope	809 (8%)	Alluvium derived from granite	> 60	A	0.20–0.24
RsC, Rositas Loamy Coarse Sand, 2-9% slope	68 (0.7%)	Alluvium derived from granite		A	
SvE, Stony Land	77 (0.8%)	-		D	
ToE2, Tollhouse Rocky Coarse Sandy Loam, 5-30% slope	2,589 (26%)	Residuum weathered from granodiorite	5–20	C	0.15
ToG, Tollhouse Rocky Coarse Sandy Loam, 30-60% slope	413 (4%)	Residuum weathered from granodiorite		C	
Total Acreage	9,854				

Notes:

[a] Hydrologic soil groups are used for estimating the runoff potential of soils on watersheds at the end of long-duration storms after a prior wetting and opportunity for swelling, and without the protective effect of vegetation. Soils are assigned to groups A through D in order of increasing runoff potential.

[b] Erosion factor Kw indicates the susceptibility of the whole soil to sheet and rill erosion by water (estimates are modified by the presence of rock fragments). The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and Ksat. Values of K range from 0.02 to 0.69. A range of values is given because map units are composed of several soil series.

[c] Wind erodibility groups are made up of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

[d] Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. The risk of corrosion also is expressed as low, moderate, or high.

[e] Shrink-swell behavior is the quality of soil that determines its volume change with change in moisture content. The volume-change behavior of soils is influenced by the amount of moisture change and amount and kind of clay in the soil. Linear extensibility is used to determine the shrink-swell potential of soils. The shrink-swell potential is low if the soil has a linear extensibility of less than 3%; moderate if 3% to 6%; high if 6% to 9%; and very high if more than 9%.

Source: USDA San Diego Area Soil Survey, 1973

2.6 Hydrogeologic Units

Boring logs were obtained for two existing JCSD wells. The subsurface lithology within the vicinity of Well 6 consists of the following:

Alluvium: The soils mapped along Boundary Creek are identified as Carrizo very gravelly sand (CeC) alluvium derived from mixed igneous rocks. Alluvium up to a depth of 81 feet bgs has been logged for monitoring wells drilled approximately 1,000 feet east-north-east of Well 6 (Conestoga-Rovers and Associates 2012). The depth of the alluvium at Well 6 is assumed to be approximately 39 feet based on the depth of the well.

Decomposed Granite (DG): Weathered bedrock consisting of decomposed granite (DG) up to 80 feet bgs was noted in JCSD well logs and for monitoring wells drilled approximately 1,000 feet east-north-east of Well 6 (Conestoga-Rovers and Associates 2012). The thickness of the DG ranged from 13 to 40 feet.

Granitic Bedrock: The crystalline bedrock is predominantly composed of granodiorite with tonalite encountered near the surface. 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 500 feet while drilling JCSD Wells 7 and 8 (Appendix A).

2.7 Hydrogeologic Inventory and Groundwater Levels

Well 6 was drilled in 2003 to a depth of 465 feet bgs and cased to 113 feet bgs. Well logs from 72 wells within the Boundary Creek watershed were identified from review of the County's well permit database. Additional analysis of the confidential well logs is required to refine thickness of hydrologic units present within the Boundary Creek watershed. Table 2-6 provides a summary of the information available from driller well logs obtained to date.

Table 2-6
JCSD Well Descriptions

Well Number	Well Completion Depth (feet bgs)/ (Year Drilled)	Depth to Water (feet btoc);date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Decomposed Granite (DG) (feet bgs)	Fractured Granite (feet bgs)
JCSD Wells						
Well 4	39[c]	6.33; 7/15/13	175[a]	0-39[b]		
Well 6	465 (2003)	2.92; 7/15/13	600+			
Well 7	518 (2008)		300+	0-10	10-23	23-520
Well 8	518 (2009)	28.67; 1/11/12	275+	0-42	42-55	55-524
Park Well		52.42; 7/15/13				

Notes:
a. Reported pumping capacity provided by JCSD.
b. Alluvial depth based on total depth of Well 4.
c. Approximate completion depth

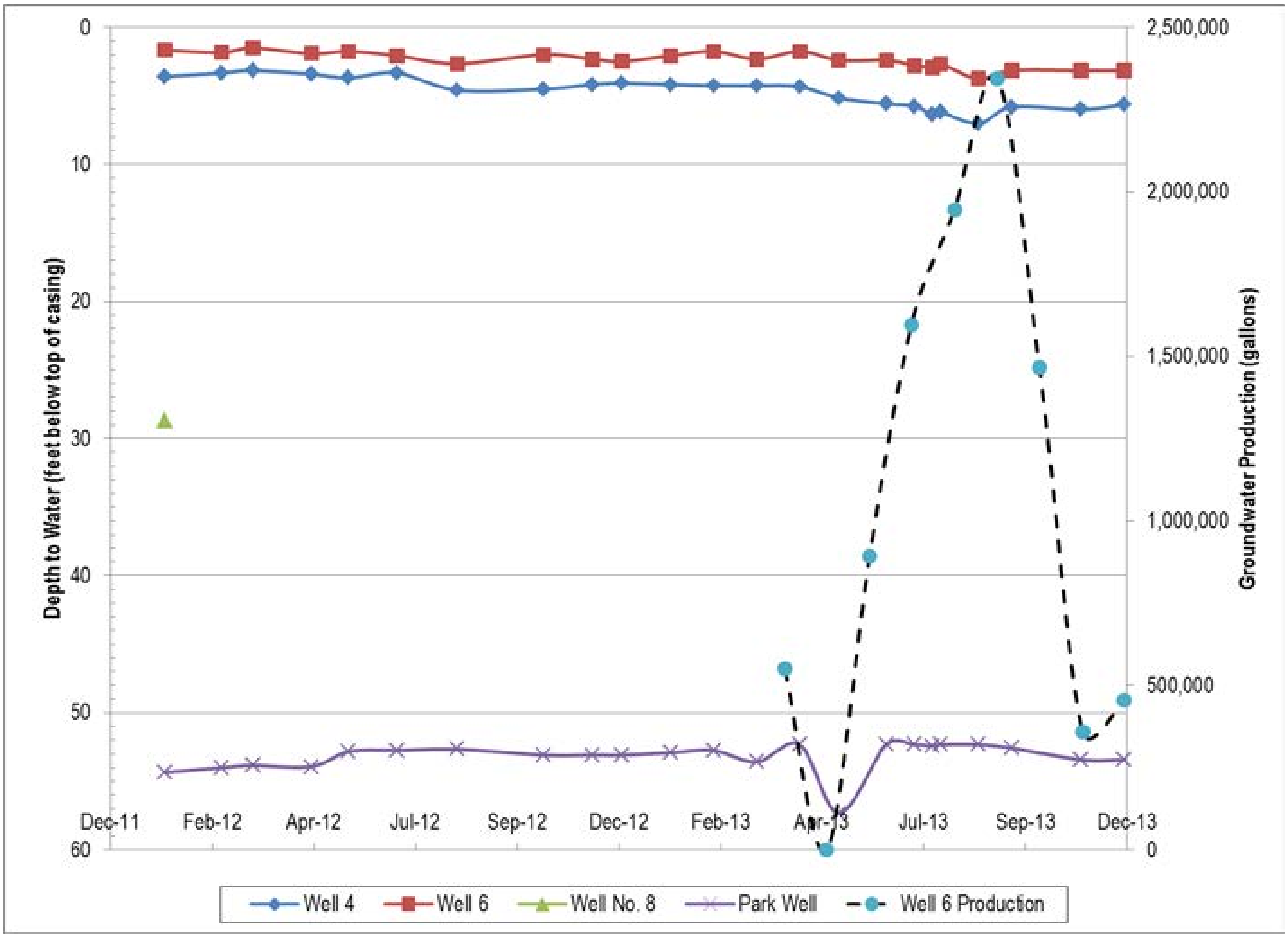
Groundwater level data were obtained from the JCSD from January 2013 through November 2013 (Troutt, pers. comm. 2013). Water level data indicate the depth to water for Wells 4 and 6 are stable over the period of record from January to September 2013 (Exhibit 2-E).

Exhibit 2-E indicates that production of 9.6 million gallons of water from Well 6 over the period from March through November 2013 has resulted in a water level decline of 1.42 feet in Well 6. Over the same 9 month period the water level in Well 4 declined 1.42 feet as approximately 24.5 million gallons of water was produced based on averaging by month the annual production to date of 30 million gallons.

2.8 Water Quality

Well 6 was initially intended for use as a potable water well; however, during drilling a hot spring aquifer was encountered. Due to elevated temperature and fluoride, the water is limited to non-potable use as discussed in further detail in Section 4.0.

Exhibit 2-E
JCSD Water Level Data January to November 2013



INTENTIONALLY LEFT BLANK

3.0 WATER QAUNTITY IMPACTS ANALYSIS

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

3.1 50% Reduction of Groundwater Storage

To estimate groundwater storage it is necessary to divide the aquifers into surface areas in which storage and recharge can be accessed by a pumping well. Typically, the watershed is defined by surface divides (ridgelines) that separate surface flow. It should be noted that surface boundaries such as ridgelines do not preclude subsurface groundwater flow between watersheds but are used to suitably approximate available storage and recharge. The watershed was defined by the boundaries of the Boundary Creek portion of the Jacumba Valley HSA depicted in Figures 4 and 7. Only the portion of the watershed contained within the United States and upstream of Well 6 was evaluated for this analysis. The area of the watershed contributing to the JCSD supply wells and located in the United Sates is approximately 9,854 acres. This analysis is conservative as 19.5% of the watershed or approximately 2,385 acres is located in Mexico and storage was not considered for this area.

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 water demands for the JCSD maintain at least 50% groundwater in storage over the 9,854-acre Boundary Creek watershed.

3.1.2 Methodology

A soil moisture balance method was used to evaluate rainfall recharge within the 9,854 acre Boundary Creek watershed. 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 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.

3.1.2.1 Groundwater Recharge

Groundwater recharge for the Boundary Creek study area 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:

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

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 below.

Precipitation

As discussed in Section 2.2, monthly rainfall data for a 30-year period, July 1982 through July 2012, collected from the Tierra del Sol and Campo rain gauges were used in this analysis. The Tierra del Sol precipitation data were provided by the County of San Diego (Allan, pers. comm. 2013). The Campo precipitation data were obtained from Western Regional Climate Center (WRCC 2012). The mean annual precipitation for Tierra del Sol and Campo rain gauges is 11.3 inches and 15.39 inches, respectively. For comparison, the regional mean annual precipitation isohyet calculated by the USGS for the Boundary Creek watershed ranges from 9 to 14 inches (Figure 4).

Evapotranspiration

Reference evapotranspiration (ETo) data are provided by the California Irrigation Management Information System (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 study area 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 study area, 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 (Allan, pers. comm. 2013). 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 Boundary Creek watershed fall into hydrologic groups A (55%), B (1%), C (30%) and D (13%) 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	Curve Number (CN) [a]	Soil Water Holding Capacity (inches)	Mean Soil Water Holding Capacity (inches)	Area (Acres)	Percent of Total Area Examined
AcG	AcG, Acid Igneous Rock Land	D	81	-	0.1	1,067	10.83%
CaB	CaB, Calpine Coarse Sandy Loam, , 2-5% slope	B	63	4.5-6.5	5.5	14	0.14%
CaC	CaC, Calpine Coarse Sandy Loam, 5-9% slope	B	63	4.5-5.5	5	15	0.15%
CaD2	CaD2, Calpine Coarse Sandy Loam, 9-15% slope	B	63	4.5-5.5	5	37	0.38%
CeC	CeC, Carrizo Very Gravelly Sand, 0-9% slope	D	81	1.5-3.0	2.25	176	1.79%
LaE2	LaE2, La Posta Loamy Coarse Sand, 5-30% slope	A	41	2.0-3.0	2.5	1,844	18.71%
LcE2	LcE2, La Posta Rocky Loamy Coarse Sand, 5-30% slope	A	41	1.0-2.0	1.5	1,531	15.54%
LdE	LdE, La Posta-Sheephead Complex, 9-30% slope	A or C	41	1.0-2.5	1.75	876	8.89%
LdG	LdG, La Posta-Sheephead Complex, 30-65% slope	A or C	41	1.0-2.0	1.5	255	2.59%
Lu	Lu, Loamy Alluvial Land	B	63	6.0-9.0	7.5	17	0.17%

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

Soil Symbol	Soil Name and Description	Hydrologic Soil Group	Curve Number (CN)[a]	Soil Water Holding Capacity (inches)	Mean Soil Water Holding Capacity (inches)	Area (Acres)	Percent of Total Area Examined
MvD	MvD, Mottsville Loamy Coarse Sand, 9-15% slope	A	41	-	4.5	66	0.67%
MvC	MvC, Mottsville Loamy Coarse Sand, 2-9% slope	A	41	4.0-5.0	4.5	809	8.21%
RsC	RsC, Rositas Loamy Coarse Sand, 2-9% slope	A	41	3.0-4.0	3.5	68	0.69%
SvE	SvE, Stony Land	D	81	-	0.1	77	0.78%
ToE2	ToE2, Tollhouse Rocky Coarse Sandy Loam, 5-30% slope	C	75	1.0-2.0	1.5	2,589	26.27%
ToG	ToG, Tollhouse Rocky Coarse Sandy Loam, 30-60% slope	C	75	-	1.5	413	4.19%

Notes:
a. Curve numbers are obtained from the San Diego County Hydrology Manual, 2003 for open brush (good) ground cover.

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 an open brush ground cover and good hydrologic condition, CNs developed for soil groups A, B, C and D are 41, 63, 75 and 81, 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 Boundary Creek watershed is approximately 49 inches over the 30 years simulation period, or 1.63 inches per year. Annual rainfall is approximately 15.42 inches per year using the Campo station rain gauge. Thus, the runoff is approximately 11% of the rainfall for this study.

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, which is 243 afy (rounded).
2. Water demand of the combined existing use and Project water demand, which is 243 afy (rounded) plus one-time off-site demand of 48 acre-feet.
3. Water demand of the combined existing use, Project water demand and full General Plan build-out, which is 331 afy plus one-time off-site demand of 48 acre-feet.

Scenario 1 evaluates groundwater recharge based on the existing 85 residences within the Boundary Creek Watershed with an assumed water demand of 0.5 afy per residence, for a combined total water demand of 42.5 afy, the water provided by JCSD Well 4 to meet municipal demand and the water provided from JCSD Well 6 to meet non-potable construction demand of the ECO Substation Project (Table 3-2).

Table 3-2
Scenario 1—Existing Conditions

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	85	0.5	42.5	1,275
JCSD Well 4 Potable Demand	1	200	200	6,000
One-time Demand for Construction				
JCSD Well 6 Non-potable Demand for ECO Substation[a]	1	48	48	48
Total Existing Water Demand Under Scenario 1[b]			242.5	7,323

Notes:
a. SDG&E ECO Substation requires a one-time extraction of approximately 48 acre-feet to meet construction water demand.
b. Includes existing domestic and municipal supply, and one-time construction demand over 30-year period evaluated.

Scenario 2 evaluates groundwater recharge based on the combined water demand of the existing 85 residences (each requiring 0.5 afy), the water provided by JCSD Well 4 to meet municipal demand and the water provided from JCSD Well 6 to meet non-potable construction demand of the ECO Substation, Tierra del Sol Solar Farm and Rugged Solar Farm projects (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	85	0.5	42.5	1,275
JCSD Well 4 Potable Demand	1	200	200	6,000
One-time Demand for Construction				
JCSD Well 6 Non-potable Demand for ECO Substation[a]	1	48	48	48
JCSD Well 6 Non-potable Demand for Soitec Projects[b]	1	48	48	48
Total Water Demand Under Scenario 2[c]			242.5	7,371

Notes:
a. SDG&E ECO Substation requires a one-time extraction of approximately 48 acre-feet to meet construction water demand.
b. Includes one-time demand for Tierra del Sol Solar Farm and Rugged Solar Farm.
c. Includes existing domestic and municipal supply, and one-time construction demands over 30-year period evaluated.

Scenario 3 evaluates groundwater recharge based on the water demand of the existing 85 residences (each requiring 0.5 afy), the water provided by JCSD Well 4 to meet municipal demand and the water provided from JCSD Well 6 to meet non-potable construction demand of the ECO Substation, Tierra del Sol Solar Farm and Rugged Solar Farm projects, combined with the full buildout of the existing General Plan (Table 3-4).

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	85	0.5	42.5	1,275
JCSD Well 4 Potable Demand	1	200	200	6,000
Additional Single-Family Residential Units (at Full General Plan Buildout)	176	0.5	88	2,640
One-time Demand for Construction				
JCSD Well 6 Non-potable Demand for ECO Substation[a]	1	48	48	48

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
JCSD Well 6 Non-potable Demand for Soitec Projects	1	48	48	48
Total Water Demand Under Scenario 3[c]			330.5	10,011

Notes:
[a] SDG&E ECO Substation requires a one-time extraction of approximately 48 acre-feet to meet construction water demand.
[b] Includes one-time demand for Tierra del Sol Solar Farm and Rugged Solar Farm.
[c] Includes existing domestic and municipal supply, and one-time construction demands combined with the full buildout of the existing General Plan over 30-year period evaluated.

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 9,854-acre area in the Boundary Creek groundwater resource study area. For this analysis, the saturated thicknesses of the alluvium, DG, and fractured granitic rock were assumed to be uniform at 0 feet, 1.2 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 Boundary Creek study area contained within the United States is estimated to be 5,495 acre-feet.

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 B.

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.

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 3,775 acre-feet, or 69% 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 3,727 acre-feet, or 68% 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 2,867 acre-feet, or 52% of the initial groundwater storage capacity.

Table 3-5
Groundwater in Storage by Scenario for Well 6

	Scenario 1a Existing Conditions	Scenario 1b Existing Conditions	Scenario 2a Existing Conditions with Off-site Water Supply	Scenario 2b Existing Conditions with Off-site Water Supply	Scenario 3a Existing Conditions with Off-site Water Supply and General Plan Build-out	Scenario 3b Existing Conditions with Off-site Water Supply and General Plan Build-out
Minimum (af)	4,315	3,775	4,267	3,727	3,568	2,867
Maximum (af)	5,495	5,495	5,495	5,495	5,495	5,495
Average (af)	5,161	4,912	5,152	4,899	4,958	4,644
Percent Minimum Groundwater in Storage Over 30-year Period	79	69	78	68	65	52

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

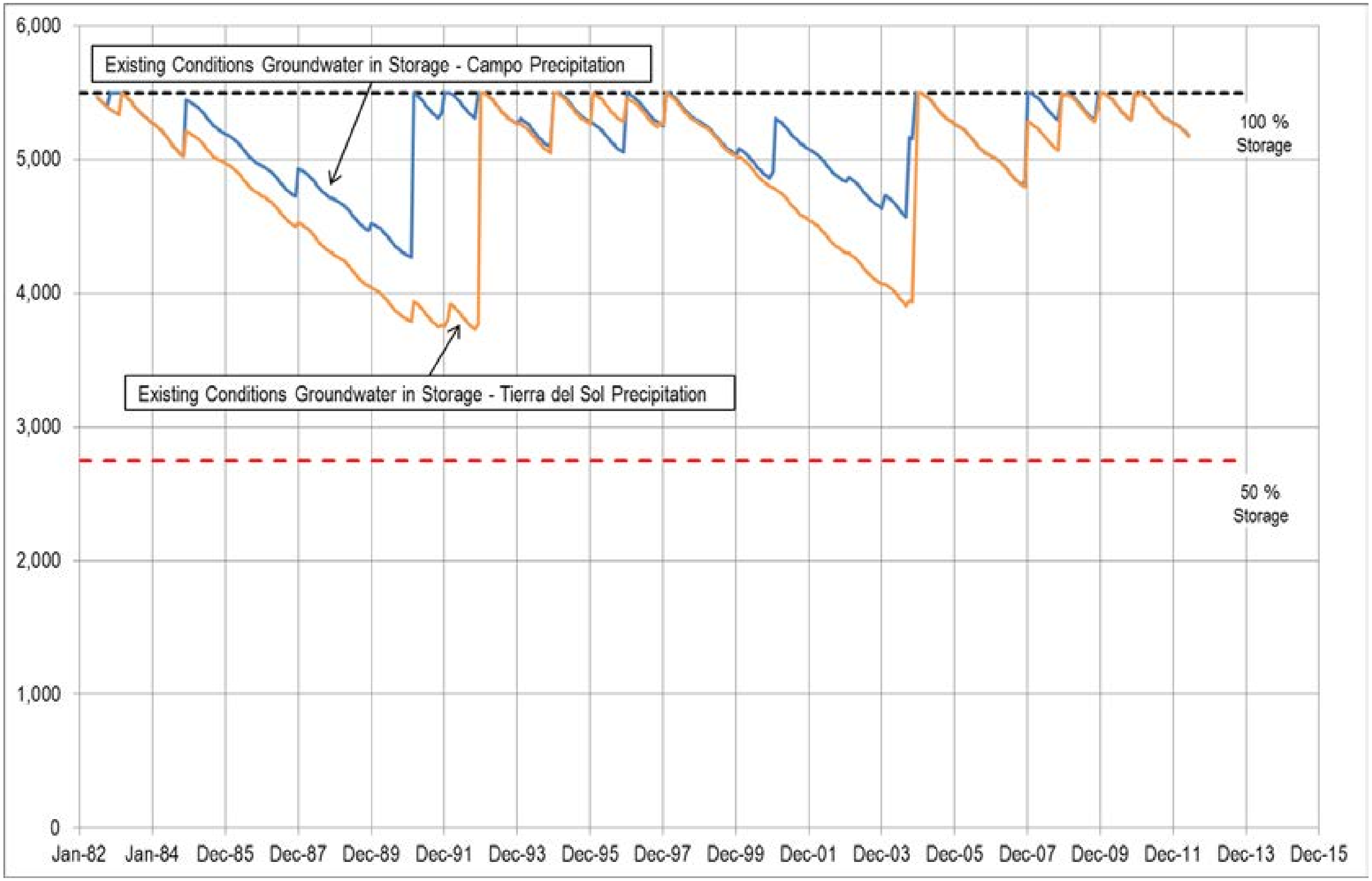


Exhibit 3-B
Scenario 2 - Existing and Off-site Water Supply Demand Groundwater in Storage

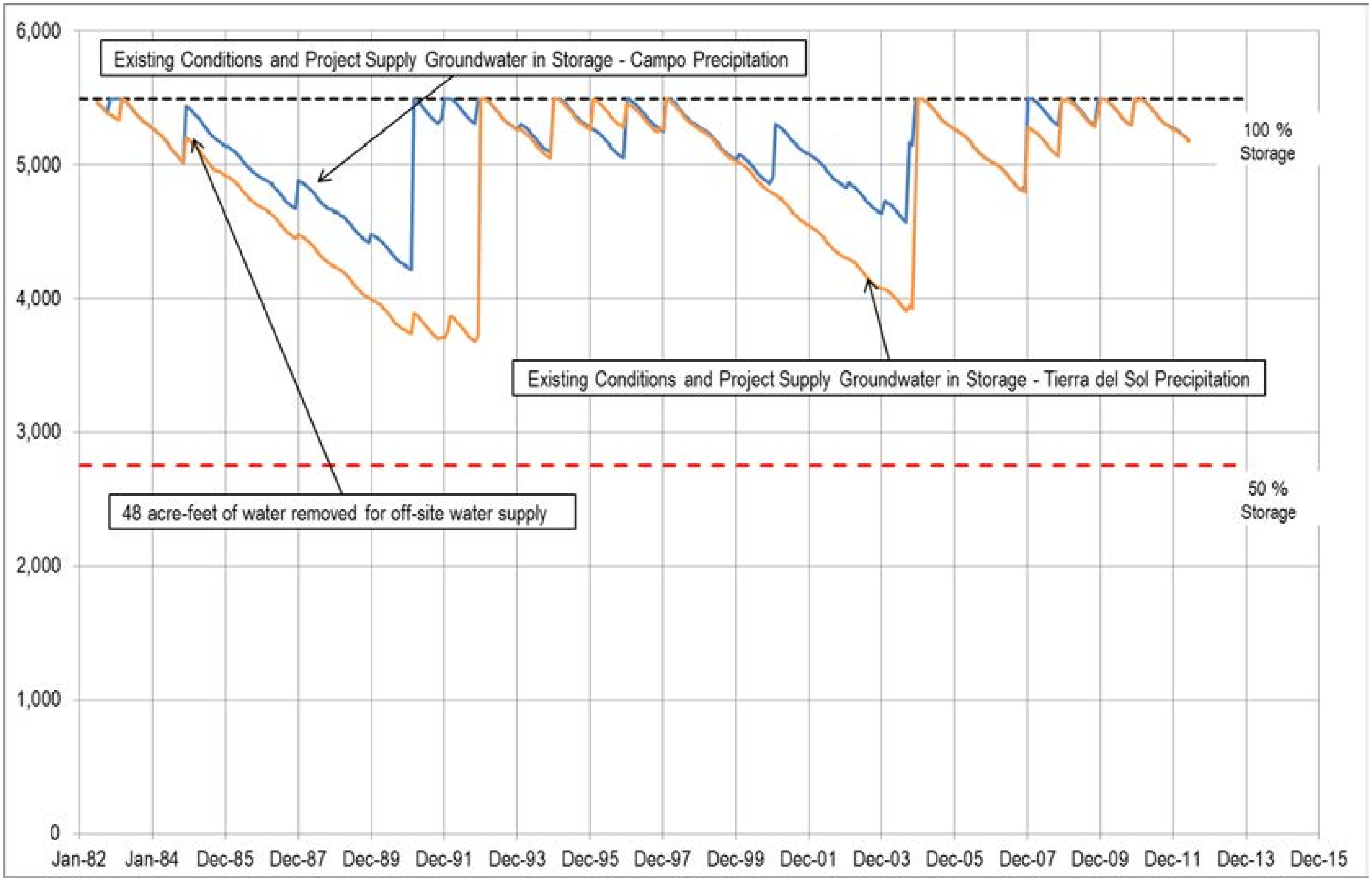
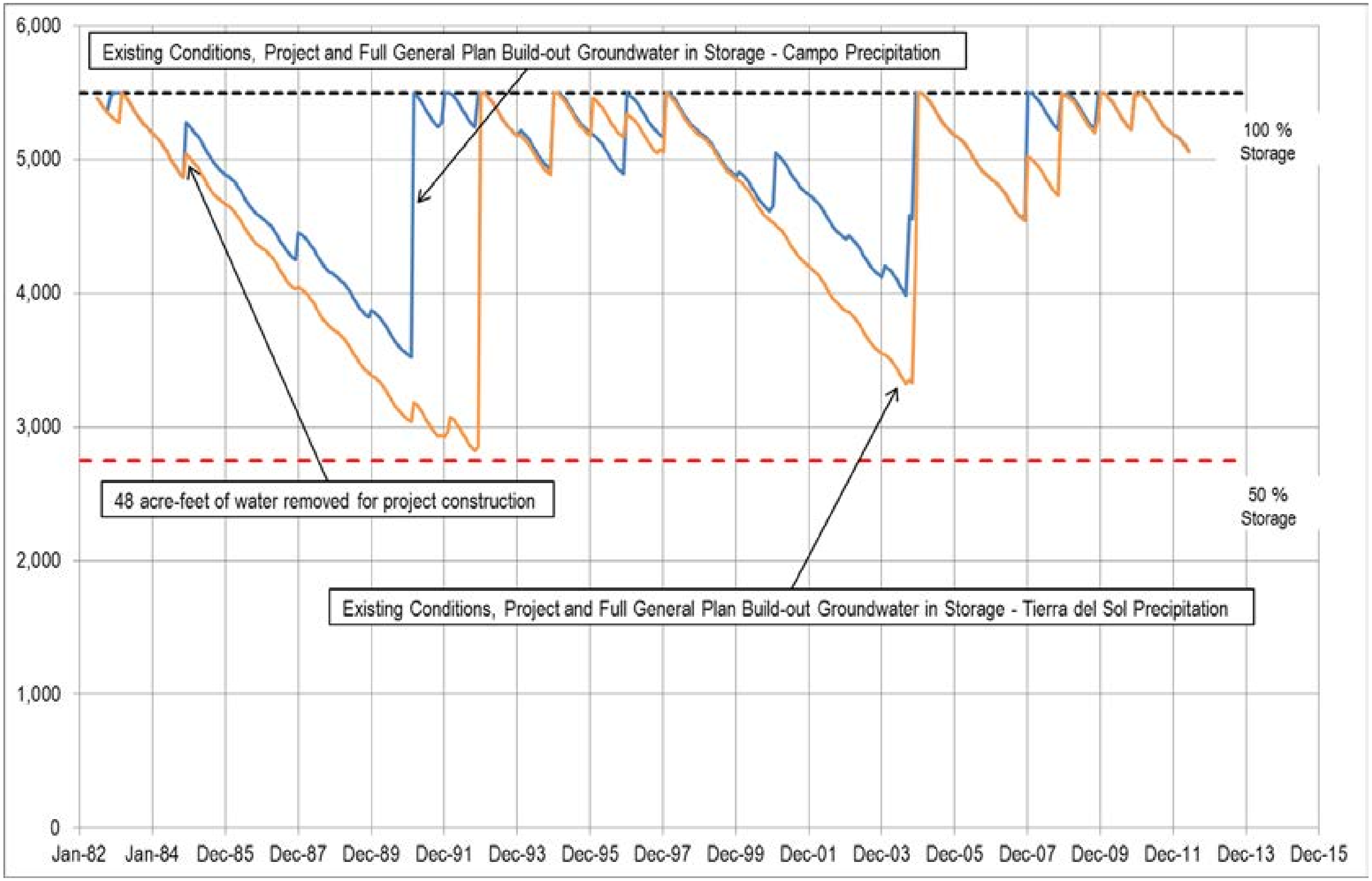


Exhibit 3-C
Scenario 3—Existing, Off-site Water Supply and Full General Plan Buildout Demand Groundwater in Storage



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 and monitoring wells.

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

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

> *Fractured Rock Well:* 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.
>
> *Alluvial Well:* 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 5 feet or more in the off-site wells. If site-specific data indicates alluvium or sedimentary rocks exist which substantiate a saturated thickness greater than 100 feet in off-site wells, 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, which remain static over time. Historically, this has been the case for the vast majority of groundwater dependent projects processed by the County. In recent years, alternative energy projects have been proposing a relatively large amount of water during the construction portion of the project, which could potentially cause direct well interference impacts from 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 drawdown analysis evaluate the potential impacts from operating at the highest rate of pumping.

A 0.5 mile radius was evaluated to determine potential well interference impacts for Well 6. Table 3-6 lists JCSD wells and private wells within 0.5 mile radius of Well 6.

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

Well Number	APN	Use	Distance from Well 6
JCSD Wells			
Well 4	660-040-32	Public/Active	60
Well 7	660-040-26	Public	1,206
Well 8	660-040-26	Public/Inactive	1,206
Park Monitoring Well		Public/Inactive	2,151
Private Confidential Wells[a]			
7965		Domestic	1,540
15216		Domestic	1,955
16137		Domestic	1,300
18049		Domestic	1,950
20019		Domestic	1,000

Notes:
a. Assessor parcel numbers are redacted for confidential well logs.

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 near Wells 4 and 6 are depicted in Figure 11. Habitat mapped adjacent to Well 4 and 6 include desert salt brush scrub and southern cottonwood-willow riparian forest (AECOM 2011). In addition, several dirt roads located within the vicinity of the wells are classified as disturbed cover type. The area to the east of the wells has been mapped as a lake/wetland on the Jacumba USGS map (Figure 2) and as freshwater emergent wetland on the U.S. Fish and Wildlife Service (FWS) National Wetland Inventory. Potentially groundwater habitat associated with Boundary Creek is mapped as riparian and bottomland habitat.

Desert saltbush scrub is composed usually of low, grayish, microphyllous shrubs, 0.3–1 meter tall, with some succulent species. Total cover is often low, with much bare ground between the widely spaced shrubs. Stands typically are strongly dominated by a single Atriplex species and found on fine-textured, poorly drained soils with high alkalinity and/or salinity, usually surrounding playas on slightly higher ground (Holland 1986). On-site, the desert saltbush scrub is found on the higher ground surrounding the southern cottonwood willow riparian forest habitat. The dominant species within the desert saltbush scrub is fourwing saltbush (*Atriplex canescens*). Other species within this habitat include London rocket (*Sisymbrium irio*) and grasses such as wild oats (*Avena sp*.) and red brome (*Bromus madritensis*) (AECOM 2011).

Southern cottonwood willow riparian forest is composed of tall, open, broadleafed winter-deciduous riparian forests dominated by cottonwoods, and several tree willows. Understories usually are shrubby willows. This habitat is usually found in sub-irrigated and frequently overflowed lands along rivers and streams. The dominant species require moist, bare mineral soil for germination and establishment. This soil is provided after floodwaters recede, leading to uniformly aged stands in this seral type (Holland 1986). The dominant species within habitat on-site are cottonwood (*Populus fremontii*), willows (*Salix sp*.) and mule fat (*Baccharis salicifolia*) (AECOM 2011).

Based on the vegetation mapped near Wells 4 and 6, both the desert saltbush scrub and southern cottonwood willow riparian forest rely on groundwater. The four-wing saltbush is a facultative phreatophyte, a deeper-rooted plant that can benefit from but does not depend on groundwater and can be tolerant of drought. Its roots extend an average of 13 feet below the ground surface

[2] Historical water level hydrographs compiled by the Jacumba Community Sponsor Group –Town Center Well Hydrographs from 1990 to 2008 indicate up to 20 feet of water level decline in one well during this period of measurement (Figure 2-58; County of San Diego 2010b). Historical water level monitoring for JCSD Well 4 from 1990 to 2008 indicates up to 20 feet of water level decline during the period of measurement (Appendix C; Figure 3).

and can reach depths of 20 feet when soil depth allows (NRCS Plant Database). The Fremont cottonwood (*Populus fremontii*) and willows are phreatophytes. Robinson (1952) reported that cottonwoods and willows rarely grow where the water table is more than 20 feet deep. Mulefat (*Baccharis salicifolia*) is phreatophyte shrub that requires groundwater levels within 12 inches from the ground surface to establish (NRCS Plant Database), and has been documented for having roots extending to 12 feet below ground surface (Robinson, 1958). The saltbush scrub and southern cottonwood willow riparian forest is approximately 25 feet and 50 feet, respectively from Well 6.

3.2.2 Well 6 Testing Methodology

The following sections (3.2.2.1 and 3.2.2.2) describe the procedures followed during the aquifer testing of Well 6.

3.2.2.1 Well Test Description

A 24-hour step test was performed for Well 6 by Fain Drilling on April 24, 2003 at pumping rates of 200 gallons per minute (gpm), 300 gpm, 400 gpm and 600 gpm, respectively. The purpose of 24-hour step test was to obtain an approximate production rate for the well. The average pumping rate was 527 gpm over the duration of the 24 hour pump test.

3.2.2.2 Well Test Analysis

After 24 hours of pumping, the maximum drawdown observed was approximately 90 feet in Well 6. The results of the Well 6 aquifer test are presented graphically in Figure 1 of Appendix C. 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]
= 527 gpm x 193 =101,711 feet^2/day
π = pi (3.14)
Δs = difference in drawdown over one log cycle (feet) = 23 feet

The transmissivity (T) calculated for Well 6 is 809.8 feet^2/day or 6,057.3 gallons per day/foot (gpd/ft).

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 data are available from an observation well during the period of the 24 hour pump test. Therefore, the storativity was not calculated.

The closest well to Well 6 is JCSD Well 4, which is located approximately 60 feet away. The following estimate of groundwater drawdown at the nearest off-site well, 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) = varies per Table 3-4
T = Transmissivity (gpd/ft) = 809.8 feet^2/day = 6,057.3 gpd/ft
t = time (days) = Calculated at 196, 365 and 1,825 days
r = distance from pumping well (feet) = varies per Table 3-4
S = coefficient of storage (dimensionless) = 0.0010 (estimated)

Drawdown at the closest well (JCSD Well 4) as a result of pumping 80,000 gpd for 196 continuous days (15.7 million gallons, or 48 acre-feet) from Well 6 is predicted to be 12 feet. If pumping 48 acre-feet is amortized over 1 and 5 year periods, predicted drawdown in Well 4 is 7 feet and 2 feet, respectively. Table 3-7 indicates projected drawdown at select distances from the pumping well using the Cooper-Jacob approximation of the Theis non-equilibrium flow equation.

Table 3-7
Well 6 Distance Drawdown Calculations

Distance from Pumping Well 6 (feet)	196 Day Production Drawdown[a] (S=0.001)	u[b]	End Year 1 Drawdown[a] (S=0.001)	u[b]	End Year 5 Drawdown[a] (S=0.001)	u[b]
25	14	0.000001	8	0.0000005	2	0.0000001
50	12	0.000004	7	0.0000021	2	0.0000004
60	12	0.000006	7	0.0000030	2	0.0000006
100	11	0.000016	6	0.0000085	1	0.0000017
250	9	0.000098	5	0.0000529	1	0.0000106
500	8	0.000394	4	0.0002115	1	0.0000423

Table 3-7
Well 6 Distance Drawdown Calculations

Distance from Pumping Well 6 (feet)	196 Day Production Drawdown[a] (S=0.001)	u[b]	End Year 1 Drawdown[a] (S=0.001)	u[b]	End Year 5 Drawdown[a] (S=0.001)	u[b]
1000	6	0.001575	4	0.0008458	1	0.0001692
1500	5	0.003544	3	0.0019031	1	0.0003806
2000	5	0.006300	3	0.0033832	1	0.0006766
2640	4	0.010978	3	0.0058949	1	0.0011790
5280	3	0.043911	2	0.0235796	1	0.0047159

Notes:

a. Amortized 196 day production rate 56 gpm, or 80,000 gpd.
b. Amortized 1 year production rate 30 gpm, or 43,000 gpd (rounded).
c. Amortized 5 year production rate 6 gpm or 8,640 gpd.
d. u valid if sufficiently small (u<0.05).

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 2; Appendix C). 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 compared to the static water level prior to well testing. This suggests long-tern recovery of the pumping well.

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 water production of 80,000 gallons per day (gpd), or 56 gpm from Well 6 results in predicted drawdown of 12 feet in Well 4 located approximately 60 feet away after 196 days of continuous pumping. If pumping is amortized over 1 year predicted drawdown is 7 feet at Well 4. Amortizing pumping over 5 years results in predicted drawdown at Well 4 of 2 feet (Table 3-4).

Site specific groundwater extraction and resulting drawdown are available as a result of the pumping and sale of water by the JCSD to SDG&E for construction use at the ECO Substation project. These site-specific drawdown observations are used as the basis for determining significance thresholds rather than the Cooper-Jacob approximation drawdown predictions. As shown in Table 2-4, Well 6 pumped 9.6 million gallons of water between March 2013 and November 2013. Water level drawdown of 1.42 feet was observed over this period in Well 6. Assuming SDG&E purchases the entire 15 million gallons of water (per their agreement with the JCSD), a total drawdown of 2.22 feet is projected at Well 6. The total volume of water demand for the Projects is 48 acre-feet or 15.7 million gallons. This would result in an additional projected drawdown of 2.58 feet at Well 6, for a combined drawdown of 4.80 feet. This is less than the County threshold of significance that results in a decrease in water level of 20 feet or more for a fractured rock aquifer. This projection assumes that the water level at the beginning of groundwater extraction for the Projects will be at the level projected at the end of the extraction of 15 million gallons of water for construction use at the ECO Substation project.

Over the same time period (March through November, 2013), approximately 24.5 million gallons of water were pumped from Well 4 to supply the JCSD potable water system. The water level in Well 4 declined 1.42 feet. Assuming the pumping rate at Well 4 does not change, it is estimated that 17.6 million gallons of water will be pumped from Well 4 for the potable water system based on the anticipated duration of 196 days for groundwater extraction for the Projects. It is estimated that this pumping will result in a water level drawdown of 0.83 feet at Well 4. This is less than the County threshold of significance that results in a decrease in water level of 5 feet or more for an alluvial well.

The historical low groundwater level in the vicinity of the desert saltbush scrub and southern cottonwood willow riparian forest is not known over the period corresponding to the lifespan of the vegetation. This lack of historical water level data precludes determination of a water level threshold 3 feet below the historical low. Additionally, there is limited hydraulic connection with the fractured rock hot spring aquifer intercepted by Well 6 with the groundwater dependent vegetation. This is evident by the different water quality and temperatures of the two aquifer systems and lack of an apparent hydraulic response in the shallower Well 4 when Well 6 is pumped (Troutt, pers. comm. 2013). Based on these site-specific observations, groundwater extraction from Well 6 is not likely to exceed the County threshold of significance.

3.2.4 Mitigation Measures and Design Considerations

As the analysis contained herein is based on limited site data and well testing, monitoring will be conducted to ensure that water levels remain stable in the JCSD wells. A GMMP, which details establishment of groundwater thresholds for off-site well interference and groundwater dependent habitat has been prepared for off-site water supply.

3.2.5 Conclusions

The analysis above indicates that off-site well interference is not predicted to be an impact as a result of off-site water supply at a pumping rate of 56 gpm amortized over a 196 day period. Water level monitoring will be performed in several wells to record water levels during groundwater extraction. A GMMP, which details establishment of groundwater thresholds for off-site well interface and groundwater dependent habitat has been prepared. Annual review of water level data should be conducted by a Certified Hydrogeologist registered in the State of California to evaluate long-term impacts.

INTENTIONALLY LEFT BLANK

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 Maximum Contaminant Levels (MCLs) for applicable contaminants. The majority of groundwater resources would be utilized for the purposes of dust control during construction.

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.

4.2.1 Sampling Procedures

To determine whether the supply well (Well 6) would exceed applicable MCLs, water samples from Well 6 were collected and analyzed between April 2003 and August 2007. The samples were analyzed by Institute for Environmental Health Environmental Engineering Laboratory of San Diego, California.

4.2.2 Sampling Analysis

A wide range of water quality analyses 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, and general physical/mineral properties. The laboratory report is included as an appendix to this report (Appendix D). 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
Well 6 Microbiological Water Quality Results

Constituent	Analytical Method	Units	Well 6 Groundwater (Sample from August 22, 2007)	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
Well 6 General Mineral Water Quality Results

Constituent	Analytical Method	Units	Well 6 Groundwater (Sample from April 24, 2003)	California Drinking Water MCLs
Cations				
Total Hardness	SM2340B	mg $CaCO_3$/L	8.1	—
Calcium	SM312B	mg/L	2.8	—
Magnesium	SM312B	mg/L	0.28	—
Sodium	SM312B	mg/L	105	—
Total Cations	*Calculated*	*meq/L*	*4.73*	—
Anions				
Total Alkalinity	SM2320B	mg $CaCO_3$/L	65.2	—
Hydroxide	SM2320B	mg $CaCO_3$/L	<0.2	—
Carbonate	SM2320B	mg $CaCO_3$/L	8.4	—
Bicarbonate	SM2320B	mg $CaCO_3$/L	62.5	—
Chloride	EPA 300	mg/L	84.4	250/500/600[a]
Sulfate	EPA 300	mg/L	21.4	250/500/600[a]
Fluoride	EPA 300	mg/L	2.72	2[b]
Nitrate (as NO_3)	EPA 300	mg/L	<0.18	45 (10 as N)
Total Anions	*Calculated*	*meq/L*	*3.99*	
Aggregate Properties				
pH	EPA 150	pH Units	9.48	6.5 – 8.5[b]
Specific Conductance	EPA 300	umhos/cm	498	900/1,600/2,200[b] (µS/cm)[c]
Solids				
Total Dissolved Solids	SM2540 C	mg/L	296	500[b]
General Physical				
Color	SM2120 B	Color Units	ND	15
Odor	SM2150 B	T.O.N.	8	3
Turbidity	SM2130 B	NTU	0.22	5
Surfactants				
MBAS	SM5540C	mg/L	<0.05	0.5

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

Table 4-3
Well 6 Inorganic Minerals Water Quality Results

Constituent	Analytical method	Units	Well 6 Groundwater (April 24, 2003)	California Drinking Water MCLs
Aluminum	EPA 3010A	ug/L	<50	1,000
Antimony	EPA 200.8	ug/L	<6.0	6
Arsenic	EPA 200.8	ug/L	<2.0	10
Barium	EPA 200.8	ug/L	<100	1,000
Beryllium	EPA 200.8	ug/L	NA[d]	4
Cadmium	EPA 200.8	ug/L	<1.0	5
Chromium (Total)	EPA 200.8	ug/L	1.1	50
Copper	EPA 200.8	ug/L	<50	1,300[a]
Fluoride	SM4500 F C	mg/L	2.72	2.0[b]
Iron	EPA 3010A	ug/L	<100	300[b]
Lead	EPA 200.8	ug/L	<5.0	15[a]
Manganese	EPA 3010A	ug/L	<20	50[b]
Mercury	EPA 245.1	ug/L	<1	0.002
Nickel	EPA 200.8	ug/L	NA[d]	0.1
Nitrate as $N0_3$ (as N)	SM4500 NO3 E	mg/L	<0.18	45 (10 as N)
Nitrite (as nitrogen)	SM4500 NO2 B	mg/L	<0.4	1 (as N)
Nitrate + Nitrite (sum as nitrogen)	Calculated	mg/L	ND[c]	10 (as N)
Selenium	EPA 200.8	ug/L	NA[d]	50
Sulfide, Iodometric	SM4500	mg/L	5.8	—
Thallium	EPA 200.8	ug/L	<1.0	2
Zinc	EPA 200.8	ug/L	<50	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).
d. not analyzed

Table 4-4
Well 6 Volatile Organic Compounds (VOCs) Water Quality Results

Constituent	Analytical Method	Units	Well 6 Groundwater (Sample from April 24, 2003)	California Drinking Water MCLs
1,1,1-Trichloroethane	EPA 524.2	ug/L	<0.50	200
1,1,1,2-Tetrachloroethane	EPA 524.2	ug/L	<0.50	
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

Table 4-4
Well 6 Volatile Organic Compounds (VOCs) Water Quality Results

Constituent	Analytical Method	Units	Well 6 Groundwater (Sample from April 24, 2003)	California Drinking Water MCLs
1,1-Dichloropropene	EPA 524.2	ug/L	<0.50	
1,2,3-Trichloropropane	EPA 524.2	ug/L	<0.50	
1,2,3-Trichlorobenzene	EPA 524.2	ug/L	<0.50	
1,2,3-Trimethylbenzene	EPA 524.2	ug/L	<0.50	
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-Dichlorobenzene	EPA 524.2	ug/L	<0.50	
1,3-Dichloropropane	EPA 524.2	ug/L	<0.50	
1,3-Dichloropropene	EPA 524.2	ug/L	<0.50	0.5
1,3,5-Trichlorobenzene	EPA 524.2	ug/L	<0.50	
1,3,5-Trimethylbenzene	EPA 524.2	ug/L	<0.50	
1,4-Dichlorobenzene	EPA 524.2	ug/L	<0.50	5
2,2-Dichloropropane	EPA 524.2	ug/L	<0.50	
Benzene	EPA 524.2	ug/L	<0.50	1
Bromobenzene	EPA 524.2	ug/L	<0.50	
Bromochloromethane	EPA 524.2	ug/L	<0.50	—
Bromodichloromethane	EPA 524.2	ug/L	<1.0	—
Bromomethane	EPA 524.2	ug/L	<0.50	
Bromoform	EPA 524.2	ug/L	<1.0	—
n-Butylbenzene	EPA 524.2	ug/L	<0.50	
sec-Butylbenzene	EPA 524.2	ug/L	<0.50	
Carbon Tetrachloride	EPA 524.2	ug/L	<0.50	0.5
Chlorobenzene	EPA 524.2	ug/L	<0.50	70
Chloroethane	EPA 524.2	ug/L	<0.50	
Chloroform	EPA 524.2	ug/L	<1.0	—
Chloromethane	EPA 524.2	ug/L	<0.50	
cis-1,2-Dichloroethene	EPA 524.2	ug/L	<0.50	6
cis-1,3-Dichloropropene	EPA 524.2	ug/L	<0.50	—
Dibromomethane	EPA 524.2	ug/L	<0.50	
Dichloromethane	EPA 524.2	ug/L	<0.50	5
Dichlorodifluoromethane	EPA 524.2	ug/L	<0.50	
Dibromochloromethane	EPA 524.2	ug/L	<1.0	—
Ethylbenzene	EPA 524.2	ug/L	<0.50	300

Table 4-4
Well 6 Volatile Organic Compounds (VOCs) Water Quality Results

Constituent	Analytical Method	Units	Well 6 Groundwater (Sample from April 24, 2003)	California Drinking Water MCLs
Hexachlorobutadiene	EPA 524.2	ug/L	<0.50	
Isopropylbenzene	EPA 524.2	ug/L	<0.50	
Methyl tert butyl Ether	EPA 524.2	ug/L	<3.0	13
Methylene Chloride	EPA 524.2	ug/L	<0.50	5
Napthalene	EPA 524.2	ug/L	<0.50	
n-Propylbenzene	EPA 524.2	ug/L	<0.50	
p-Isopropyltoluene	EPA 524.2	ug/L	<0.50	
Styrene	EPA 524.2	ug/L	<0.50	100
tert-Butylbenzene	EPA 524.2	ug/L	<0.50	
Tetrachloroethene	EPA 524.2	ug/L	<0.50	5
Toluene	EPA 524.2	ug/L	<0.50	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	EPA 524.2	ug/L	<1.0	1,750

Table 4-5
Well 6 Radiochemistry Water Quality Results

Constituent	Analytical Method	Units	Well 6 Groundwater (Sample from May 9, 2007)	California Drinking Water MCLs
Radium 228	EPA Ra5	pCi/L	0.0363	15
Radium 228 Counting Error	EPA Ra5	pCi/L	0.576	—
Uranium	EPA 200.8	pCi/L	ND	20

pCi/L = picocuries per liter

4.3 Significance of Impacts Prior to Mitigation

Because water from Well 6 is only intended for non-potable use, the impact 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

4.5 Conclusions

Water quality analyses indicate that groundwater pumped from Well 6 is suitable for use for construction activities such as dust control and to obtain optimum soil moisture for compaction during grading.

5.0 SUMMARY OF PROJECT IMPACTS AND MITIGATION

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 9,854 acre contributing watershed to Well 6. 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 52% 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 0 feet, 1.2 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, based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, drawdown at the closest well (JCSD Well 4) as a result of pumping from Well 6 after 196 days, 1 year and 5 years is predicted to be 12 feet, 7 feet, and 2 feet, respectively (Table 3-4). These results would indicate that well interference is predicted to exceed the County threshold of significance of a decrease in water level of 5 feet or more in off-site alluvial wells (County of San Diego 2007). However, the shallow alluvial aquifer is not hydraulically connected to the deep fractured rock hot springs aquifer in which Well 6 is completed. Site specific data indicate that well interference is not expected exceed the County threshold of significance for either the alluvial or fractured rock aquifers. A drawdown of 4.8 feet is estimated at Well 6 as a result of extracting 15 million gallons of water from Well 6 for ECO Substation construction as well as 15.7 million gallons of water from Well 6 for the Projects. Additionally, predicted drawdown at Well 4 during the anticipated period of groundwater extraction for the Projects is estimated to be 0.83 feet. This drawdown is due to pumping at Well 4 to supply the JCSD potable water system. The estimated drawdown in Wells 4 and 6 are less than the County threshold of significance.

5.3 Groundwater Dependent Habitat

As presented in Section 3.2.1.2, both the desert saltbush scrub and southern cottonwood willow riparian forest mapped adjacent to Well 6 rely on groundwater. The saltbush scrub and southern cottonwood willow riparian forest is approximately 25 feet and 50 feet, respectively from Well 6. Well 4 is located approximately 60 feet from Well 6 and is completed in the alluvial aquifer. Based on the observed water level drawdown at Well 4 of 1.42 feet over a 9 month period in which Well 6 pumped 9.6 million gallons and Well 4 pumped 24.5 million gallons, as well as the estimated drawdown of 0.83 feet in Well 4 during the period of groundwater extraction for the Projects, projected water level in the alluvial aquifer is not expected to exceed the County threshold of significance. Drawdown in the alluvial aquifer due to pumping at Well 6 is estimated to be less than drawdown in the fractured rock aquifer, as the deeper hot spring aquifer is not hydraulically connected to the shallow aquifer. This is evident by the different water quality and temperatures of the two aquifer systems.

The historical low groundwater level in the alluvial aquifer underlying the desert saltbush scrub and southern cottonwood willow riparian forest is not known over the period corresponding to the lifespan of the vegetation. However, historical water level data from Well 4 from 1990 to 2008 indicates a maximum depth to water of 23 feet bgs during the period of measurement. As the estimated drawdown in Well 4 is 0.83 feet during the Projects and the current water level is 5.67 feet bgs, the groundwater level in the alluvial aquifer is not expected to approach the historical low water level. Therefore, impacts to groundwater dependent habitat would be less than significant.

5.4 Water Quality

As presented in Section 4.0, water quality analyses of Well 6 indicates elevated temperature and fluoride. As JCSD Well 6 is a non-potable well that has water quality suitable for construction use, groundwater impacts from water quality would be less than significant.

5.5 Mitigation Measures

Monitoring will be in place during production from Well 6 to ensure that impacts to groundwater storage, well interference and groundwater dependent habitat do not occur. A GMMP has been prepared, which details establishment of groundwater thresholds for off-site well interface and groundwater dependent habitat.

6.0 REFERENCES

AECOM, 2011. Energia Sierra Juarez (ESJ) Well Access Road – Project Number 09-0107420 Biological Letter Report. February 3, 2011.

Allan, R.B. 2013. Unpublished precipitation data from Jacumba and Tierra del Sol rain gauges. Personal communication from R. Allan (County of San Diego Flood Control). September 13, 2013.

Conestoga-Rovers and Associates. 2012. Monitoring Well Installation and Soil Boring Report Former Chevron Service Station 44485 Old Highway 80, Jacumba, California. Case No. H29832-002. May 1, 2012.

Dudek, 2013a. Draft Groundwater Resources Investigation Report Rugged Solar Farm Project.

Dudek, 2013b. Draft Groundwater Resources Investigation Report Tierra del Sol Solar Farm Project.

DWR (California Department of Water Resources) and UCCE (University of California Cooperative Extension). 2000. A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California, The Landscape Coefficient Method and WUCOLS III. Accessed August 2013. http://www.water.ca.gov/wateruseefficiency/docs/wucols00.pdf.

CIMIS (California Irrigation Management Information System). 1999. "ETo Zones Map." CIMIS. 1999. Accessed August 2013. http://www.cimis.water.ca.gov/cimis/cimiSatEtoZones.jsp.

County of San Diego. 2013. San Diego County Groundwater Ordinance – An Excerpt from the San Diego County Code of Regulatory Ordinances. Amendments effective March 1, 2013.

County of San Diego. 2011. San Diego County General Plan – A Plan for Growth, Conservation and Sustainability. Adopted August 3, 2011.

County of San Diego. 2010a County of San Diego, Guidelines for Determining Significance and Report Format and Content Requirements: Biological Resources. Land Use and Environment Group, Department of Planning and Land Use, Department of Public Works. Fourth Revision. September 15, 2010.

County of San Diego. 2010b General Plan Update – Final Groundwater Study. Department of Planning and Land Use. April 2010.

County of San Diego (DPLU). 2007 County of San Diego, Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources. Land Use and Environment Group, Department of Planning and Land Use, Department of Public Works. March 19, 2007.

County of San Diego. 2004. Groundwater Limitations Map. On file with the Clerk of the Board of Supervisors as Document No. 195172. April 2, 2004.

Holland, R.F., 1986. Preliminary descriptions of the terrestrial natural communities of California. State of California, The Resources Agency, Nongame Heritage Program, Dept. Fish & Game, Sacramento, Calif. 156 pp.

Integrated Urban Forestry. 2001. Adaptability of native plant species to groundwater fluctuations for Sycamore Ranch. Laguna Hills, California, 2001.

Jacumba Community Services District (JCSD). 2010. Permission for ESJ U.S. to file an Application for a Major Use Water Extraction Permit – Jacumba Community Services District. Letter dated May 27, 2010.

National Research Council. 2002. Riparian Areas – Functions and Strategies for Management, Committee on Riparian Zone Functioning and Strategies for Management. Water Science and Technology Board, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. National Research Council. National Academy Press, 2002.

NRCS. 2013. Custom Soil Resource Report for San Diego County Area, California, based on San Diego County Survey Area, Version 6, December 17, 2007. Accessed September 2013. http://websoilsurvey.nrcs.usda.gov.

NRCS Plant Database: http://plants.usda.gov/java/

Robinson, T. W. 1952. Phreatophytes and their relation to water in western United States. Transactions American

Geophysical Union 33(1):57-61

Swenson, G. A., 1981. Master's Thesis San Diego State University – The Groundwater Hydrology of Jacumba Valley, California and Baja California.

Troutt, D. 2013. JCSD Well 4 Annual Groundwater Production. Personal communication from D. Troutt (General Manger Jacumba Community Services District). December 4, 2013.

WRCC (Western Regional Climate Center). 2012. "Period of Record General Climate Summary—Temperature: Campo, California." WRCC. Accessed November 2012. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca1424.

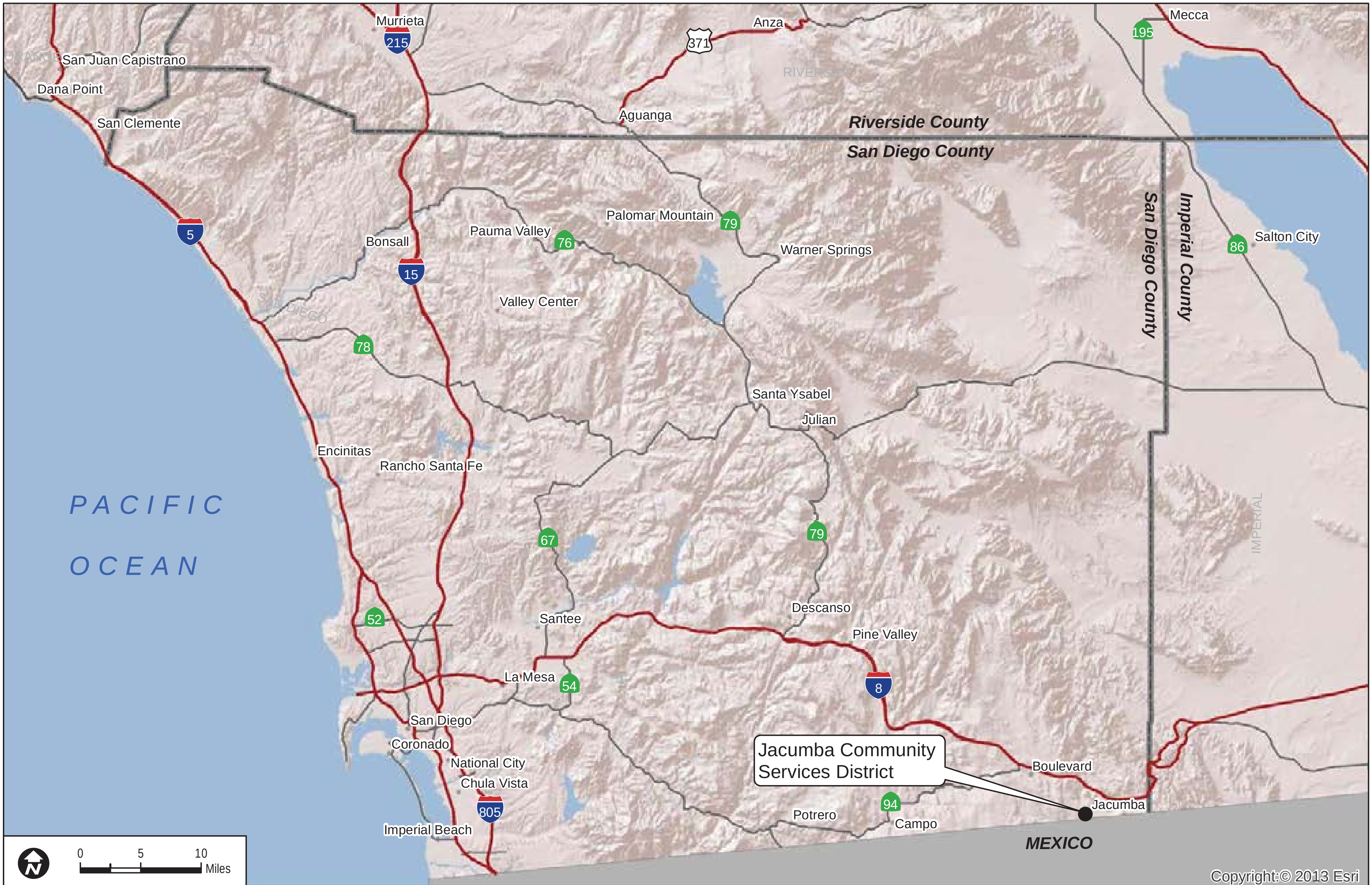
US Census. 2010. U.S. Department of Commerce. United States Census Bureau. http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml. Accessed September 25, 2013.

USGS. 2004. "Preliminary Geologic Map of the El Cajon 30' x 60' Quadrangle, Southern California." Version 1.0. 1:100,000. Compiled by V.R. Todd. USGS.

7.0 LIST OF PREPARERS AND PERSONS AND ORGANIZATIONS CONTACTED

This report was prepared by Dudek Hydrogeologist Trey Driscoll, PG, CHG. 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. Graphics and GIS mapping and analyses were provided by Saurabh Thapar, PE. 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. Debby Troutt, General Manger, Jacumba Community Services District assisted with background information and data for this report.

INTENTIONALLY LEFT BLANK



DUDEK

7122

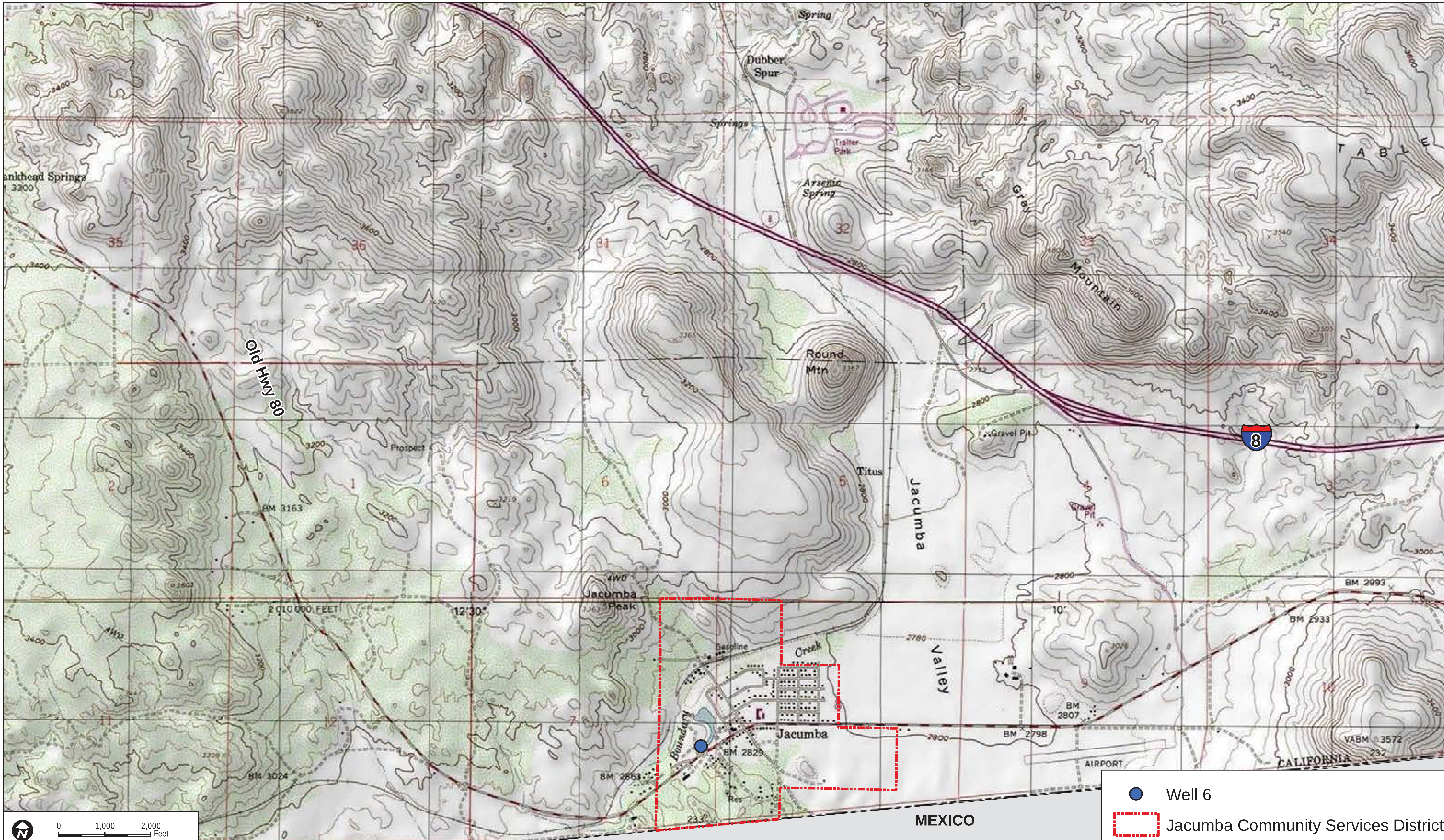
DECEMBER 2013

FIGURE 1

Regional Location

FINAL GROUNDWATER RESOURCES INVESTIGATION REPORT - JACUMBA COMMUNITY SERVICES DISTRICT

INTENTIONALLY LEFT BLANK



DUDEK

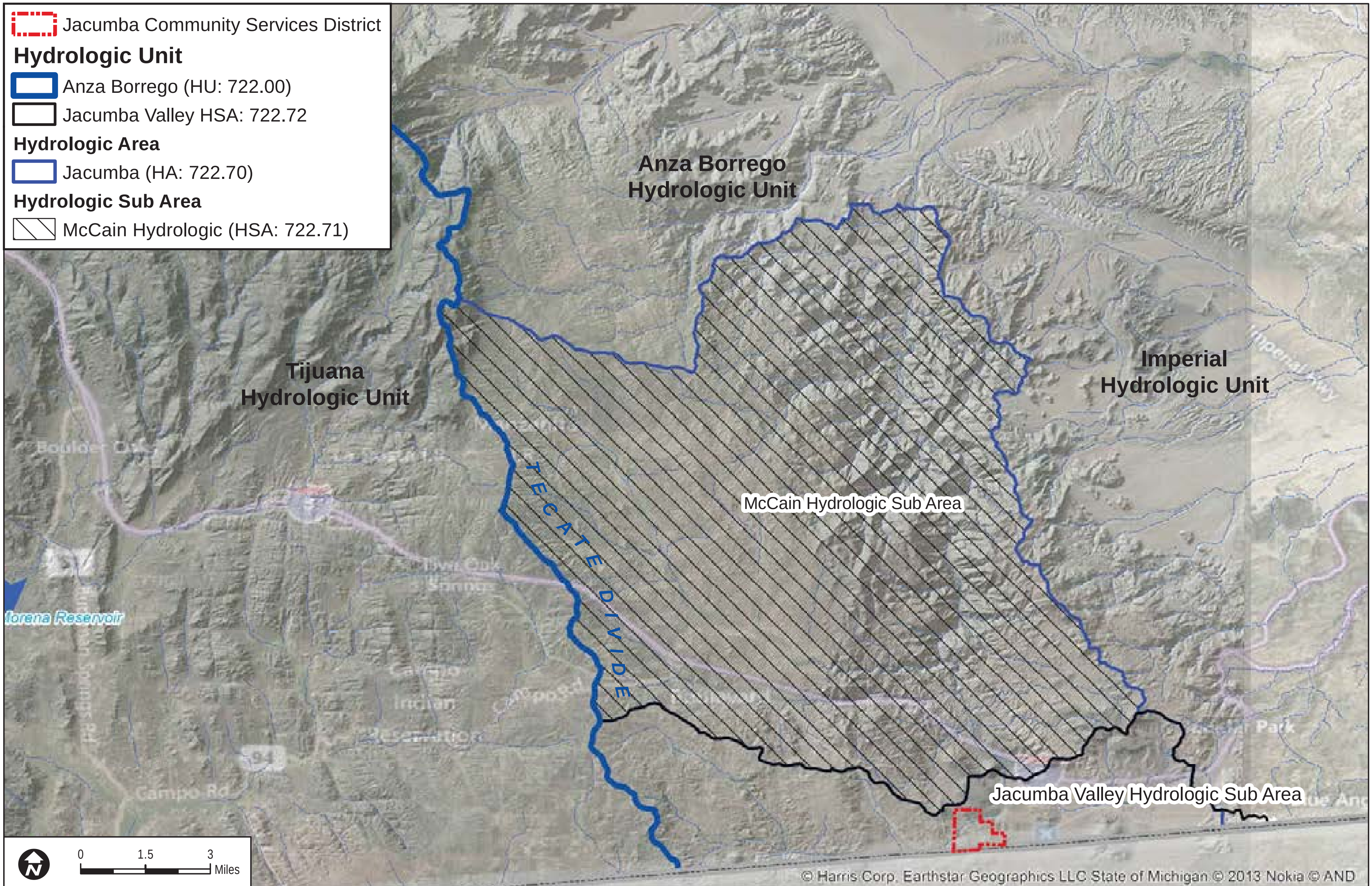
7122
DECEMBER 2013

SOURCE: Bing Maps, SanGIS 2010

FIGURE 2
Vicinity Map

FINAL GROUNDWATER RESOURCES INVESTIGATION REPORT - JACUMBA COMMUNITY SERVICES DISTRICT

INTENTIONALLY LEFT BLANK



DUDEK

7122

DECEMBER 2013

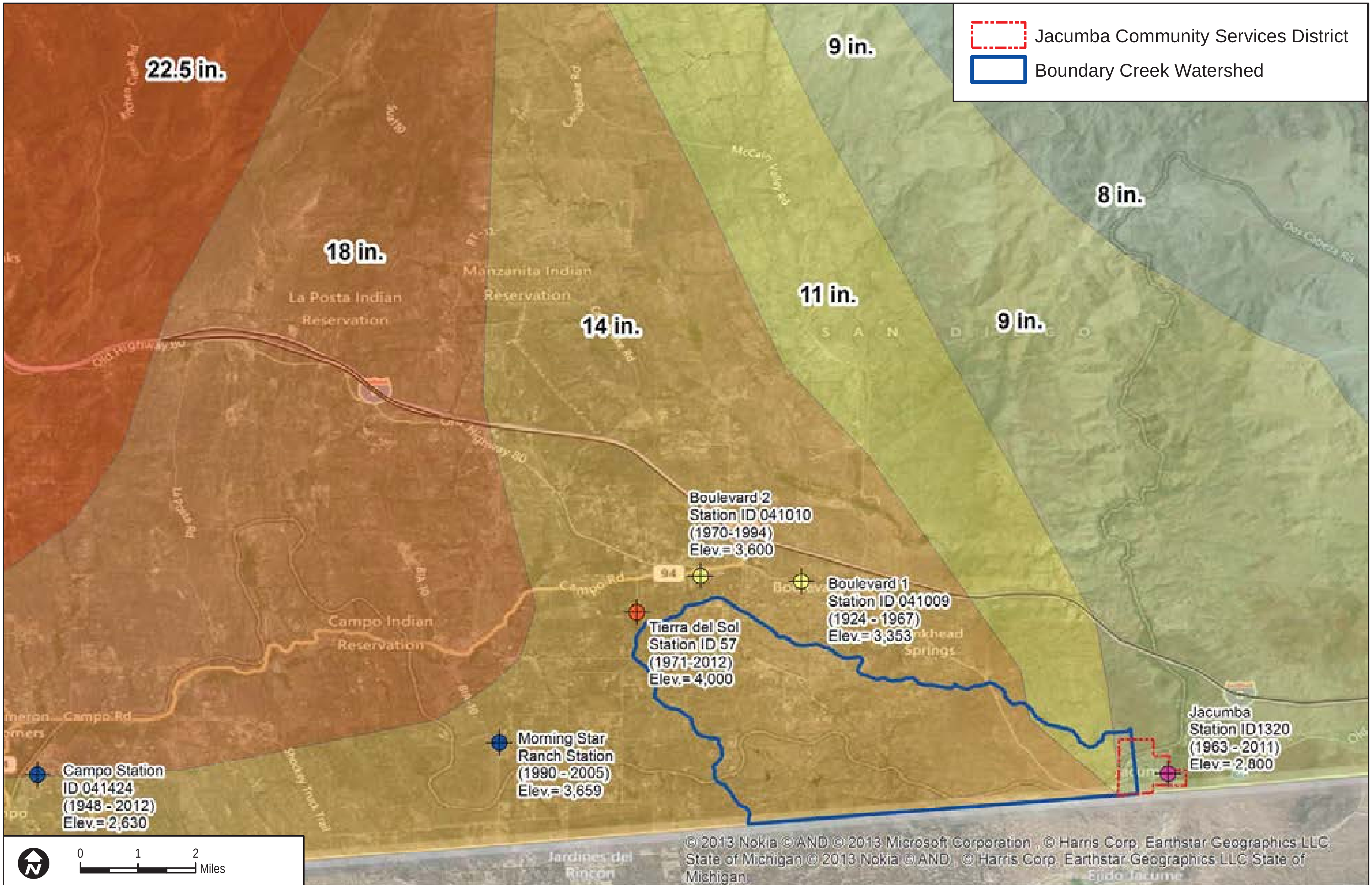
SOURCE: U.S. Geological Survery National Hydrography Dataset (USGS 2012)

FIGURE 3

Hydrologic Areas

FINAL GROUNDWATER RESOURCES INVESTIGATION REPORT - JACUMBA COMMUNITY SERVICES DISTRICT

INTENTIONALLY LEFT BLANK



DUDEK

7122

DECEMBER 2013

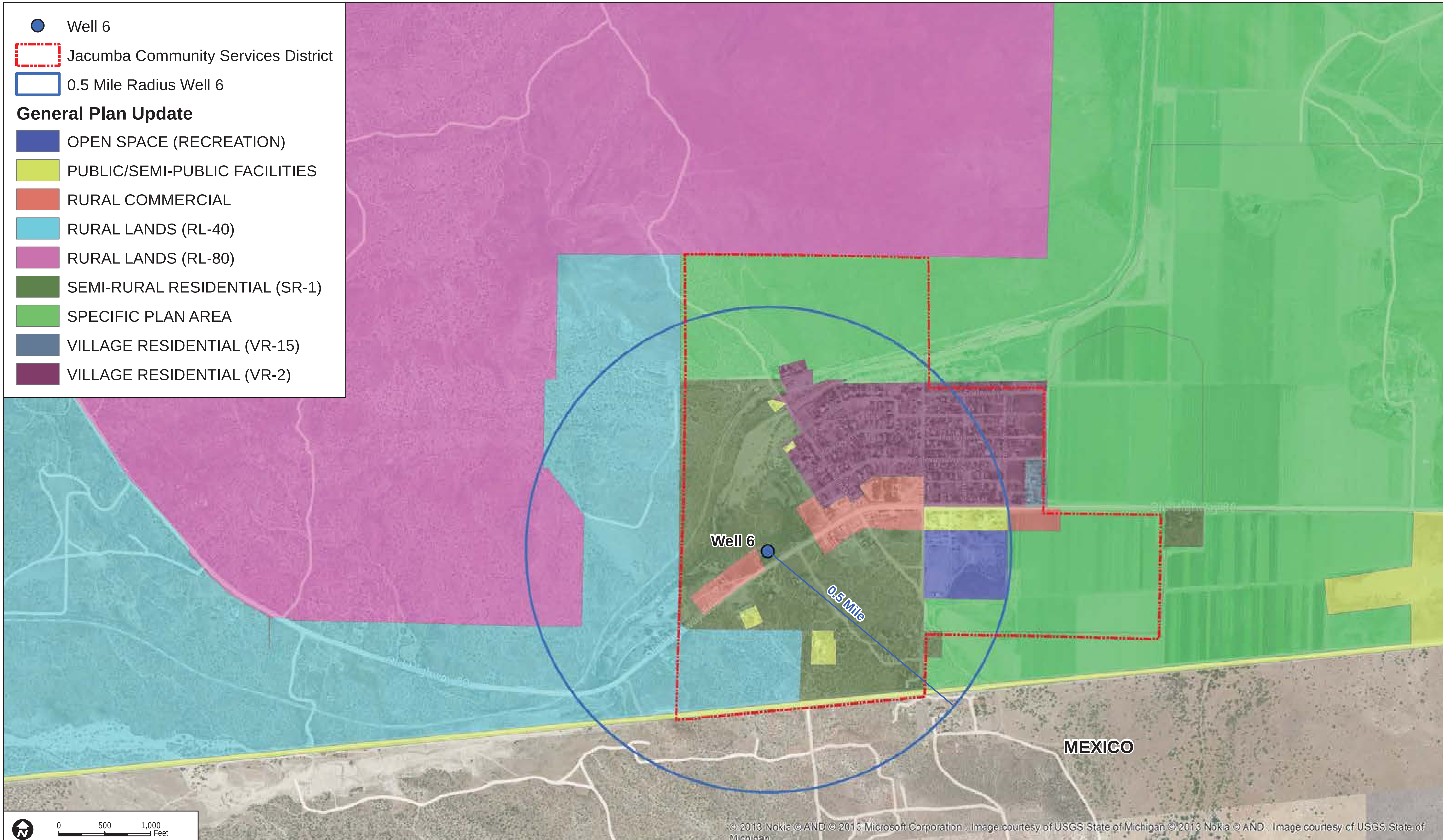
SOURCE: NOAA, County of San Diego,

FIGURE 4

Regional Mean Annual Precipitation

FINAL GROUNDWATER RESOURCES INVESTIGATION REPORT - JACUMBA COMMUNITY SERVICES DISTRICT

INTENTIONALLY LEFT BLANK



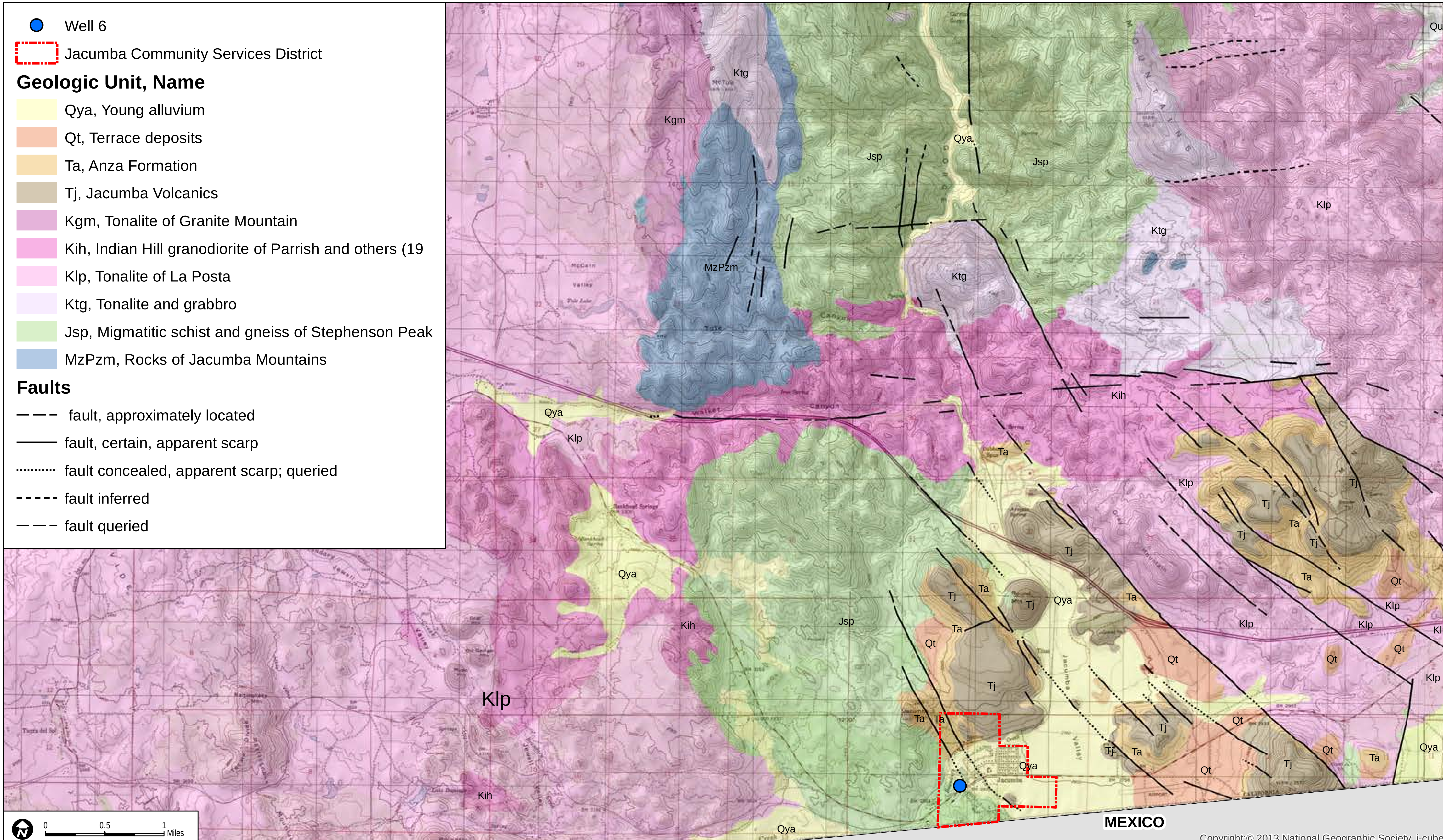
DUDEK

7122
DECEMBER 2013

SOURCE: Bing Maps, SanGIS

FIGURE 5
Current General Plan Land Use

INTENTIONALLY LEFT BLANK



DUDEK

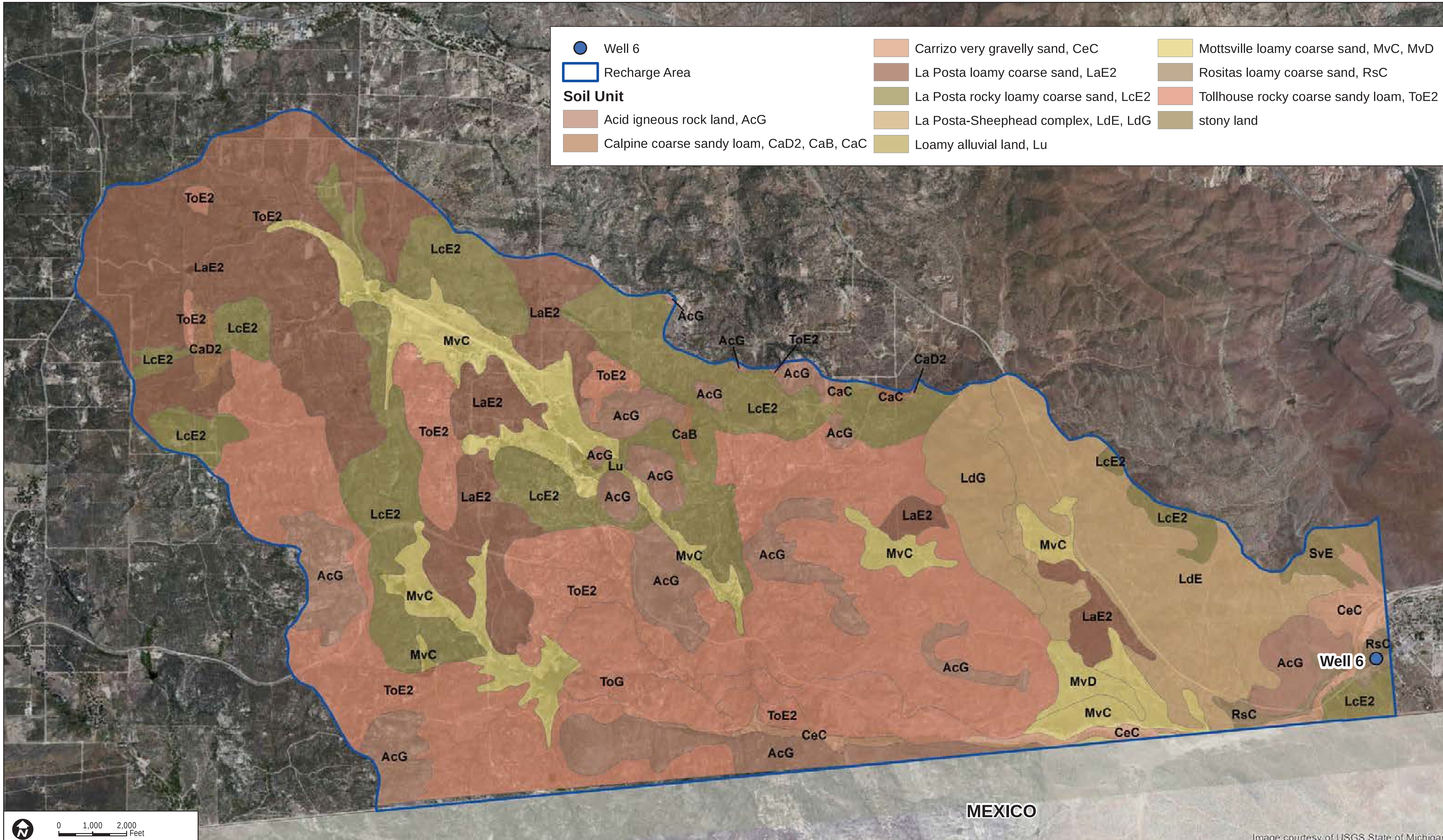
7122
DECEMBER 2013

SOURCE: Todd 2004, SanGIS 2012, National Geographic 2013.

FIGURE 6
Regional Geologic Map

FINAL GROUNDWATER RESOURCES INVESTIGATION REPORT - JACUMBA COMMUNITY SERVICES DISTRICT

INTENTIONALLY LEFT BLANK



DUDEK

7122
DECEMBER 2013

SOURCE: Bing Maps, SanGIS 2010

FIGURE 7
Soils Map

FINAL GROUNDWATER RESOURCES INVESTIGATION REPORT - JACUMBA COMMUNITY SERVICES DISTRICT

INTENTIONALLY LEFT BLANK