FINAL

Groundwater Resources Investigation Report
Rugged Solar Farm Project
Major Use Permit 3300-12-007
Boulevard, 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:

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

REGISTERED PROFESSIONAL GEOLOGIST
STEPHEN K. DICKEY
No. 1070
Exp. 5/30/15
PG CEG CHG
STATE OF CALIFORNIA

Stephen K. Dickey, PG, CHG, CEG

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GLOSSARY OF TERMS AND ACRONYMS

AC	Alternating Current
ACOE	Army Corps of Engineers
afy	acre-feet per year
amsl	above mean sea level
APN	Assessor's Parcel Number
bgs	below ground surface
btoc	below top of casing
CDFG	California Department of Fish and Game
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CN	Curve Number
CNM	Curve Number Method
County	County of San Diego
CPV	Concentrator Photovoltaic
CWC	California Water Code
DC	Direct Current
DG	Decomposed Granite
DPLU	Department of Planning and Land Use
DWR	Department of Water Resources
ET	Evapotranspiration
ETo	Reference Evapotranspiration
EPA	Environmental Protection Agency
GAMA	Groundwater Ambient Monitoring and Assessment
GMMP	Groundwater Monitoring and Mitigation Plan
gpd	gallons per day
gpd/ft	gallons per day/foot
gpm	gallons per minute
HP	Horsepower
HSA	Hydrologic Subarea
IFSAR	Interferometric Synthetic Aperture Radar
K	Thousands
kV	Kilovolt
MCLs	Maximum Contaminant Levels
MG/L	Milligrams per Liter
MUP	Major Use Permit

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

EXECUTIVE SUMMARY

This report describes a groundwater resource investigation for the proposed Rugged Solar Farm Project (Project), a 765-acre solar energy system to be constructed and operated on privately-owned land located north of Interstate 8 (I-8) to the east of Ribbonwood Road and primarily west of McCain Valley Road in southeast San Diego County. Previous Groundwater Investigation Reports were prepared for the site by Geo-Logic Associates (GLA) for the Tule Wind Farm Project (December 2010) and for the adjacent Rough Acres Ranch Campground Project (September 2012). A new production well (Well 6b) that had not been previously tested or analyzed by GLA was drilled on the Project site in August 2012. Additionally, Well 8, which had previously been tested and analyzed by GLA, was re-drilled and new well casing was installed to a deeper depth. Starting in November 2012, a monitoring well network consisting of 7 existing on-site wells and 5 existing off-site wells was established to determine baseline conditions of groundwater levels and evaluate potential impacts to groundwater levels resulting from the Project. Wells 6a, 6b and 8 were tested in December 2012 and January 2013 to satisfy requirements of the County Planning Guidelines for Determining Significance and Report Format and Content Requirements: Groundwater Resources (County of San Diego 2007). This report documents the results of Dudek's fieldwork, well monitoring, aquifer testing, and analysis of the groundwater-related impacts related to the proposed Project.

Project supply wells have been divided into two distinct groundwater resource study areas as follows: Well 6a and 6b study area and Well 8 study area. The study areas were defined to allow specific analysis of water levels, aquifer testing and evaluation of significant impacts for each pumping center.

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

- The short-term water demand for the Project construction is expected to be 19.4 million gallons, or 59 acre-feet over an approximate 1 year period. Of the total construction demand, 44 acre-feet will be supplied from on-site supply wells with up to 16 acre-feet supplied from off-site sources.
- Annual Project operating demand, post-construction, is expected to require approximately 2.83 million gallons, or 8.7 acre-feet per year (afy). All operational water demands will be supplied from on-site wells. This is a relatively low water demand and corresponds to a long-term average pumping rate of 16.2 gpm if the well is operated an average of 8 hours per day and is equivalent to the demand associated with 18 single family residences located on the 765 acre property.

Wells 6a and 6b Study Area

- Groundwater occurs within alluvium, weathered rock, and in unweathered fractured rock underlying the 0.5-mile radius study area surrounding Wells 6a and 6b. There is an estimated 1,506 acre-feet of water in storage in the study area with an average annual groundwater recharge rate of 57 afy based on average annual rainfall of 13.5 inches per year.
- There is sufficient long-term availability of groundwater for the Project within the 0.5-mile radius study area surrounding Wells 6a and 6b based on a water budget analysis, which indicated that the amount of groundwater storage will not be reduced to a level of 50% or less as a result of Project pumping.
- Well interference with off-site wells was not observed during the 12 hour step and 72 hour constant rate aquifer tests conducted concurrently on Wells 6a and 6b.
- Potential long-term water level drawdown at the nearest property with a residential well (1,742 feet) as a result of Project pumping from Wells 6a and 6b after 5 years is predicted to be 2.6 feet using the Hantush leaky aquifer curve fitting solution. This would be considered to be a less than significant impact based on the County of San Diego well interference threshold (typically 20 feet based on a maximum 5% impact to a 400-foot deep well).
- Potential long-term water level drawdown at the nearest property line (439 feet south) as a result of Project pumping from Wells 6a and 6b after 5 years is predicted to be 3.3 feet using the Hantush leaky aquifer curve fitting solution. This would be considered to be a less than significant impact based on the County of San Diego well interference threshold (typically 20 feet based on a maximum 5% impact to a 400-foot deep well).
- As the historical low groundwater level in the vicinity of the groundwater-dependent habitat is unknown, significant impacts to groundwater dependent habitat, defined as a drop of 3 feet or more from historical low groundwater levels (County of San Diego 2010), may result due to groundwater extraction from Wells 6a and 6b. Monitoring consisting of tree surveys and measurement of alluvial aquifer water levels is provided to document potential impacts. A groundwater threshold consisting of a maximum water level drawdown in the alluvium is provided.
- Water quality analysis of Well 6b indicates that all constituents sampled are below U.S. Environmental Protection Agency (EPA) and State of California drinking water maximum contaminant levels (MCLs); therefore, project impacts due to use of potable water would be less than significant for Well 6b.

- The transmissivity calculated for the combined pumping from Wells 6a and 6b during the 72 hour constant rate test is 931.1 square feet per day (feet^2/day) or 6,964 gallons per day/foot (gpd/ft) using the Theis Recovery solution, which best fit the data with a sum of squares of 0.056. This transmissivity was calculated using the data collected from the observation well (Well 6). The coefficient of storage calculated from data obtained in Well 6 is 0.0012 for the 72 hour constant rate test performed on Wells 6a and 6b.

Well 8 Study Area

- Groundwater occurs within alluvium, weathered rock, and in unweathered fractured rock underlying the 0.5-mile radius study area surrounding Well 8. There is an estimated 1,004 acre-feet of water in storage in the study area with an average annual groundwater recharge rate of 67.8 afy based on average annual rainfall of 13.5 inches per year. Recharge is greater in the study area surrounding Well 8 as the soil types within 0.5 miles of Well 8, allow for more infiltration than those within 0.5 miles of Wells 6a and 6b.
- There is sufficient long-term availability of groundwater for the Project within the 0.5-mile radius study area surrounding Well 8 based on a water budget analysis, which indicated that the amount of groundwater storage will not be reduced to a level of 50% or less because of Project pumping.
- Potential long-term drawdown as a result of Project pumping from Well 8 after 5 years at the nearest off-site well (McCain Conservation Camp Well) located 1,800 feet from Well 8 is predicted to be 3.5 feet. This would be considered to be a less than significant impact based on the County of San Diego well interference threshold (typically 20 feet based on a maximum 5% impact to a 400-ft deep well).
- No significant impact to groundwater-dependent habitat is likely to occur due to groundwater extraction form Well 8 because the vegetation communities near the well do not rely on groundwater from the alluvial water table.
- Water quality analysis of Well 8 indicates that elevated gross alpha and uranium concentrations were detected. The uranium concentration of 21.5 +/- 2.70 pico curies per liter (pCi/L) detected in Well 8 exceeds the California drinking water MCL of 20 pCi/L. As the range of the analytical error for uranium may result in a concentration less than the MCL, Dudek recommends additional radiochemistry analysis. If additional analysis indicates Well 8 continues to exceed the drinking water MCL for uranium, wellhead treatment would be required to use the well water as drinking water. No treatment would be required for Well 8 for non-potable use.

- The transmissivity estimated for Well 8 calculated from the data collected from the observation well (Well 8a) using the Thesis recovery solution is 163.3feet^2/day or 1,221.5 gpd/ft, which best fit the data with a sum of squares of 25.99. The coefficient of storage calculated from data obtained in Well 8a is 0.0013 for the Well 8 pump test.

A separate Groundwater Monitoring and Mitigation Plan (GMMP) has been prepared for the Project (Dudek 2013), which details thresholds for off-site well interference and groundwater dependent habitat. The GMMP provides recommendations for ongoing on-site and off-site water level monitoring and establishes 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 Rugged LLC by Dudek for submittal to County of San Diego Planning and Development Services (PDS; formerly DPLU) to satisfy groundwater resource investigation scoping requirements outlined in Guidelines for Determining Significance and Report Format and Content Requirements—Groundwater Resources (County of San Diego 2007). This report is also prepared in accordance with the project-specific Well Test Plan approved by the County PDS (Appendix A).

1.2 Project Location

The approximately 765-acre Project is located north of Interstate 8 (I-8) to the east of Ribbonwood Road and primarily west of McCain Valley Road (Figure 1 and Figure 2). More specifically, Rugged is located east of Ribbonwood Road and includes the following assessor's parcel numbers (APNs): 611-060-04, 611-090-02, 611-090-04, 611-091-03, 611-091-07, 611-100-01, 611-100-02, 612-030-01, and 612-030-19; and a property (APN 611-110-01) located adjacent to and east of McCain Valley Road. The proposed solar farm would consist of four discrete, non-contiguous areas on either side of the ephemeral Tule Creek corridor, and would be crossed from east to west by an access road associated with the Tule Wind Project. The study area lies within the Live Oak Springs U.S. Geological Survey (USGS) 7.5-minute quadrangle, Township 17 South, Range 7 East, Sections 8, 9, 15, 16 and 17 (Figure 2).

1.3 Project Description

As proposed, the Project would produce up to 80 MW of alternating current (AC) generating capacity and would consist of approximately 3,588 concentrator photovoltaic (CPV) trackers on 765 acres in the unincorporated community of Boulevard, California. In addition to the CPV trackers and inverter transformer units, Rugged includes the following primary components:

- A collection system linking the CPV trackers to the on-site project substation consisting of (i) 1,000 volt (V) direct current (DC) underground conductors leading to (ii) 34.5 kilovolt (kV) underground and overhead AC conductors.
- A 7,500 square feet (sf) (60 feet x 125 feet) operations and maintenance (O&M) building.
- A 2 acre on-site private collector substation site with a pad area of 6,000 sf (60 feet x 100 feet) with maximum height of 35 feet and includes a 450 sf (15 feet by 30 feet) control house.

Upon completion, electrical production would be monitored on site at the O&M annex and off site through a SCADA system.

Primary access to the Project would be from Ribbonwood Road and McCain Valley Road. One roadway would be constructed off site from Ribbonwood Road leading to the northwest building block. Access to the central building block would be provided via McCain Valley Road. The central building block would also include an access road leading south crossing Tule Creek to provide access to the southern building block. The eastern building block will be accessed via an access road leading from McCain Valley Road crossing beneath the Sunrise Powerlink. The Rugged solar farm would tie into the Tule Wind Project (Major Use Permit (MUP) 3300-09-019) gen-tie alignment as adopted by the Board of Supervisors on August 8, 2012. The 138 kV gen-tie for the Tule Wind Project would include a 69 kV undersling line to service the Rugged Solar Farm Project. Rugged Solar LLC and Tule Wind LLC have a joint-use agreement in place for use of the gen-tie line, associated transmission towers, and access road.

Project construction will consist of several activities conducted over an approximate 1 year time period including site preparation, development of staging areas and site access roads, and solar CPV assembly and installation. After site preparation, initial project construction will include the development of the staging and assembly areas, and the grading of site access roads for initial CPV installation. CPV tracker installation would include four tracker installation and assembly phases. The anticipated water demand associated with both construction activities as well as the ongoing operation and maintenance needs of the project are provided in Section 2.4.

1.4 Applicable Groundwater Regulations

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

The County Guidelines for Determining Significance—Groundwater Resources contain a series of thresholds for determining significance of water use impacts specific to groundwater quantity and groundwater quality. To evaluate Project impacts to groundwater quantity, a water balance analysis is typically required in combination with pumping tests of existing wells to evaluate potential changes in water levels associated with groundwater use. This involved conducting supply well testing that consists of a step-drawdown test followed by a minimum 72 hour constant rate pump test at each well location. Data obtained from the well testing were then used to evaluate the long-term availability of groundwater within the basin. The County Guidelines for Determining Significance—Groundwater Resources contains the following guideline that, if met, would be considered a significant impact to local groundwater resources as a result of project implementation:

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

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

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

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

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

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2.0 EXISTING CONDITONS

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

2.1 Topographic Setting

The Project is located just east of the Tecate Divide, a series of ridgelines separating drainages that discharge to the Salton Sea from drainages that discharge to the Pacific Ocean. The Project is located in the McCain Hydrologic Subarea (HSA; 722.71), which is contained in the Jacumba Hydrologic Area (HA; 722.70) all within the Anza Borrego Hydrologic Unit (HU; 722.00) that drains toward the Salton Sea (Figure 3).

Elevations on the Project range from approximately 3,510 feet above mean sea level (amsl) in the easternmost portion of the site, east of McCain Valley Road, to approximately 3,680 feet amsl in the northern portion of the site. The topography in the watershed consists of some steep areas with scattered rock outcroppings and other relatively flat areas with vegetation, including oak trees and alkali meadows. The site encompasses a portion of Tule Creek, an intermittent creek that runs to the southwest in an open area between 500 and 1,000 feet wide and with a slope of about 1% (AECOM 2012b).

2.2 Climate

Boulevard experiences warm summer months and cool winters. Average temperatures vary greatly within the region. Mean maximum temperatures in the summer months reach the high-80s to low-90s (degrees Fahrenheit), while dropping into the high-60s (degrees Fahrenheit) in the fall months. Temperatures may fall below freezing in the winter, with snow levels occasionally below 2,500 feet. Table 2-1 displays the average monthly, and annual minimum and maximum temperatures from the Campo weather station located approximately 12 miles southwest of the Project at 32°37' North latitude, 116°28' West longitude, and an elevation of 2,630 feet. Temperature records are not available for the other weather stations discussed below that also have precipitation records.

Table 2-1
Climate Temperature Data Recorded at Campo Weather Station

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

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

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

Table 2-2
Rain Gauges in Project Area

Station	Location	Elevation (feet amsl)	Years of Operation	Average Annual Rainfall (inches)	Source
Boulevard 1	N 32°40', W 116°17'	3,353	1924 to 1967	14.8	NOAA
Boulevard 2	N 32°40', W 116°18'	3,600	1969 to 1994	17.0	NOAA
Tierra del Sol	N 32°39', W 116°19'	4,000	1971 to 2012	10.6	County
Morning Star Ranch	N 32°37', W 116°21'	3,659	1990 to 2005	15.8	Ponce
Campo	N 32°37', W 116°28'	2,630	1948 to 2012	14.3	WRCC

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

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

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

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

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

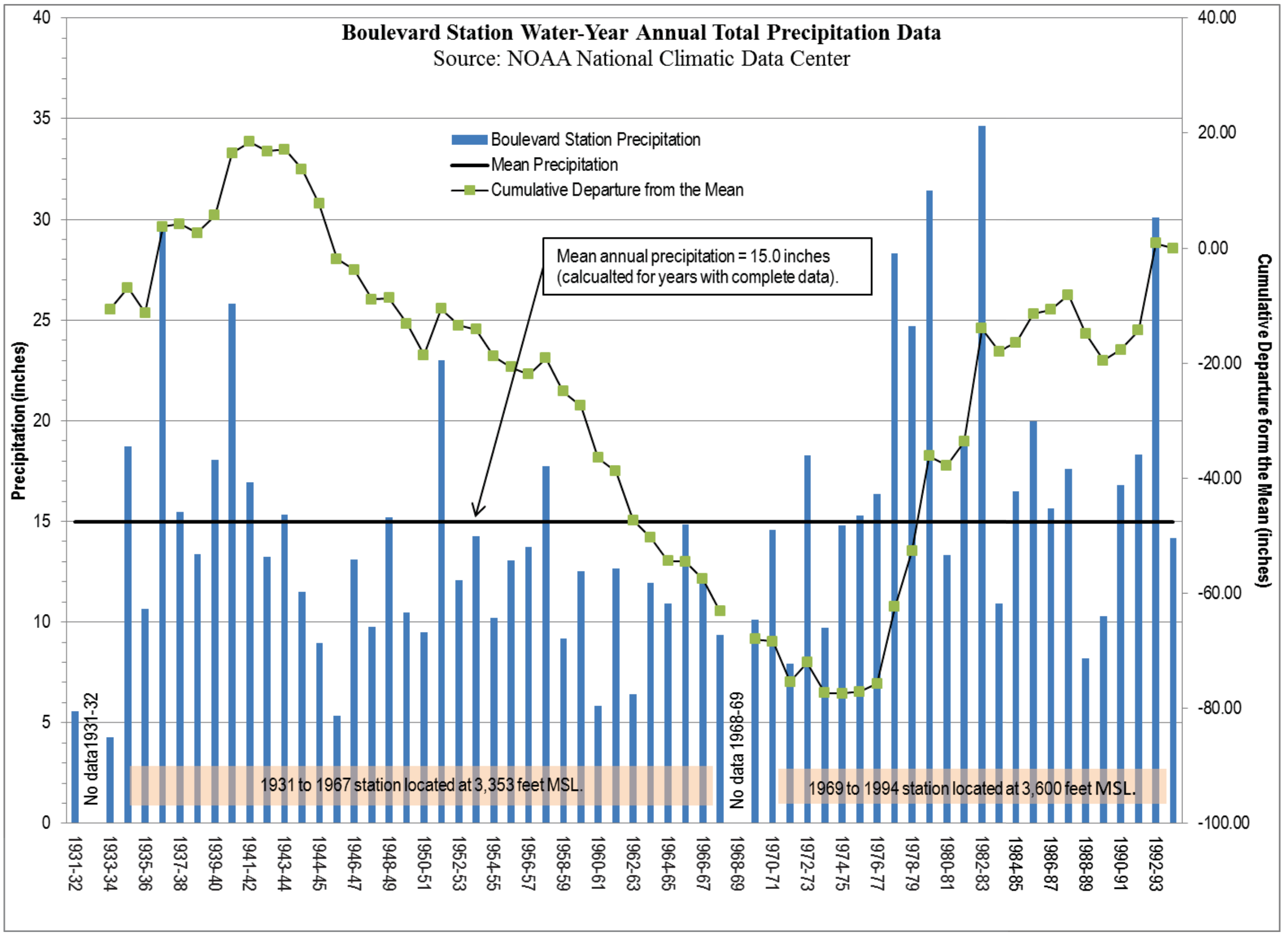
Using the historical precipitation records from 1971 to 2012 for the Tierra del Sol station located at 32°39' North latitude, 116°19' West longitude, and an elevation of 4,000 feet, average annual precipitation over a 28-year period is approximately 10.6 inches (Exhibit 2-B). A comparison of the available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

Sol station (Exhibit 2-C and Exhibit 2-D). Precipitation measured at Campo station from 1982 to 2011 indicates an average annual precipitation of 15.2 inches, as compared to only 11.4 inches at Tierra del Sol over the same 30-year period (Exhibit 2-C). Precipitation data measured at the Morning Star Ranch from 1990 to 2005 (Ponce 2006), located approximately 6.5 miles southwest of the Project at 32°37' North latitude, 116°21' West longitude, and an elevation 3,659 feet, indicates an average annual precipitation of 15.9 inches as compared to only 12.6 inches at the Tierra del Sol station over the same 15-year period. The regional mean annual precipitation isohyet calculated by the USGS for the Project site is reported as 14 inches for a majority of the Project site and as 11 inches for a small portion of the Project site (Figure 4). The Project site lies within the 12 to 15 inch precipitation band on the San Diego County Groundwater Limitations map. Based on the County map, the average annual precipitation is assumed to be 13.5 inches for the Project site.

The discrepancy in rainfall recorded at the Tierra del Sol station as compared to the other 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 the Boulevard station 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 station is located about 8 feet above the ground on a ridgeline subject to fairly high winds during storms. This, difference in gauge height and local wind strength, could account for a significant portion of the discrepancy between the stations (Allan, pers. comm. 2012). The rain gauge that previously existed at the Boulevard station and the rain gauge at the Campo station are standard rain gauges commonly used by the National Weather Service (NWS) for official rain gauge manual observations. The rain gauge at the Tierra del Sol station is a tipping bucket rain gauge typically used in automated observations. Each type of rain gauge has its own unique rain-catch characteristics. Because of how the rainfall is directed into the tipping bucket, it frequently registers a lower amount of rain relative to the standard rain gauge (Allan, pers. comm. 2012).

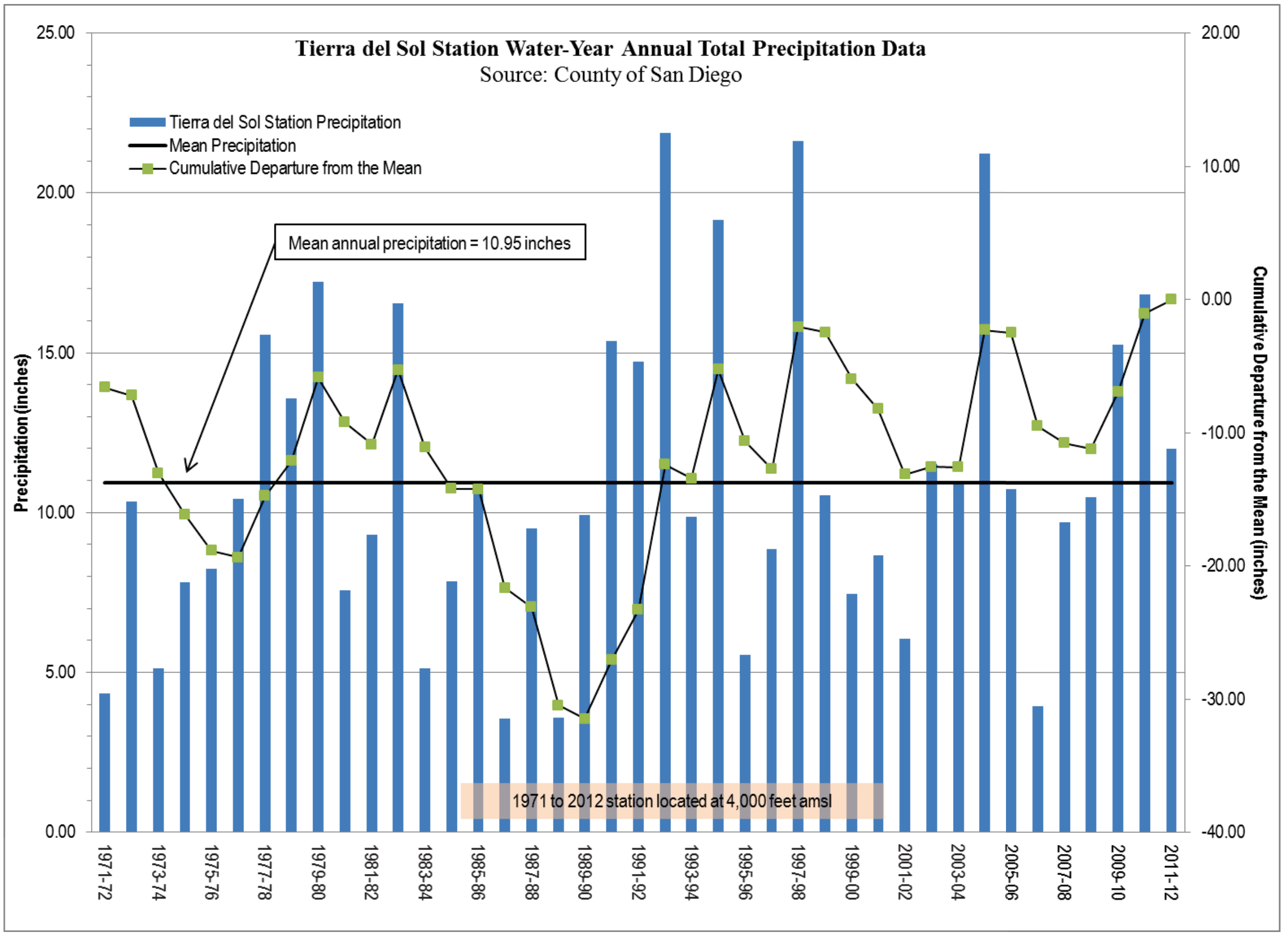
Based on review of local rainfall data in the Project area, it appears that the Tierra del Sol rain gauge underestimated rainfall by 20% to 27% during the last 30-year period. Therefore, the water balance analysis presented in Section 3 that uses the Tierra del Sol precipitation data likely underestimates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

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



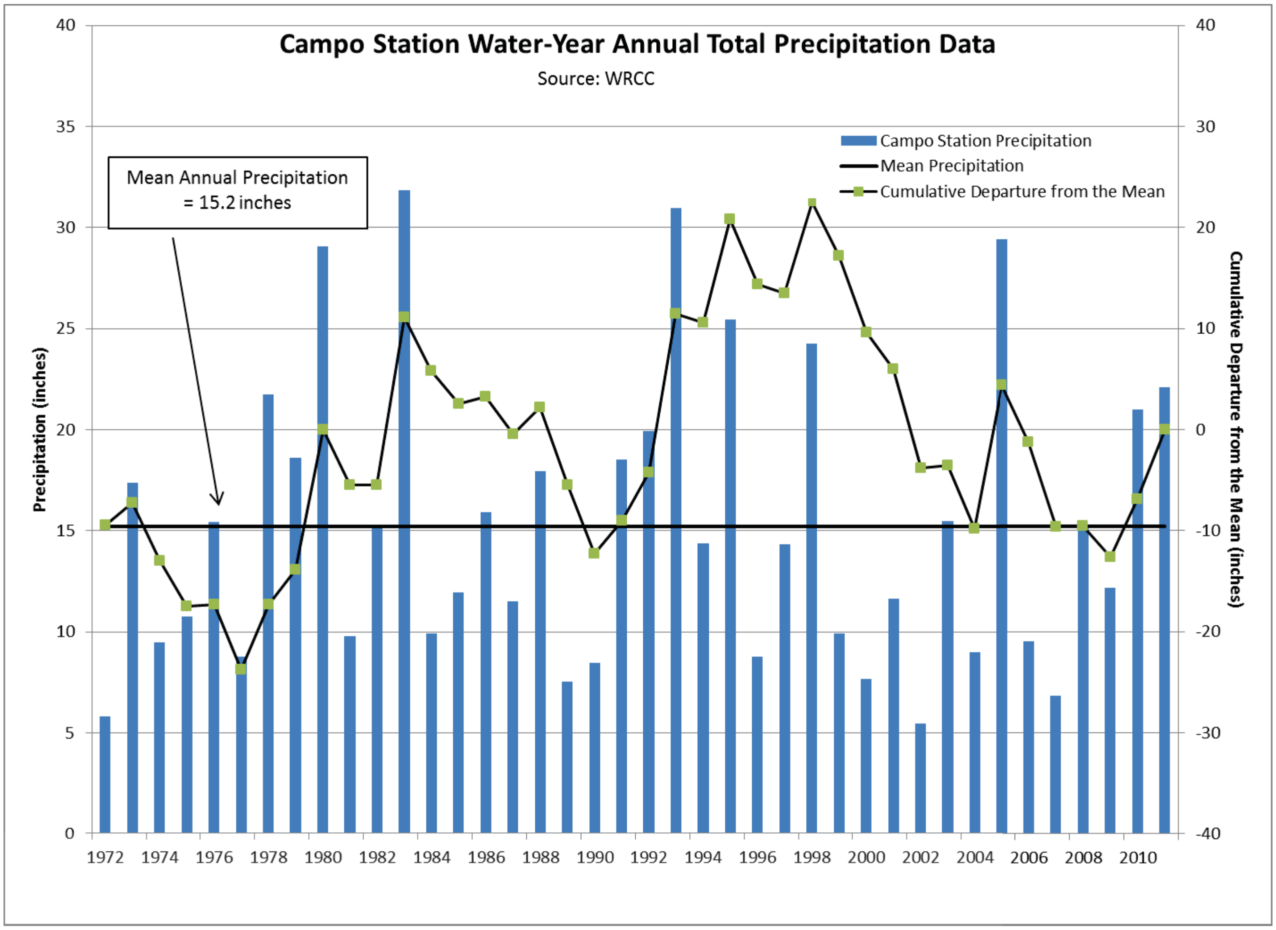
Notes: Boulevard station 1 located at N 32°40', W 116°17' at an elevation of 3,353 feet from 1924-1967.
Boulevard station 2 located at N 32°40', W 116°18' at an elevation of 3,600 from 1969 to 1994.

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



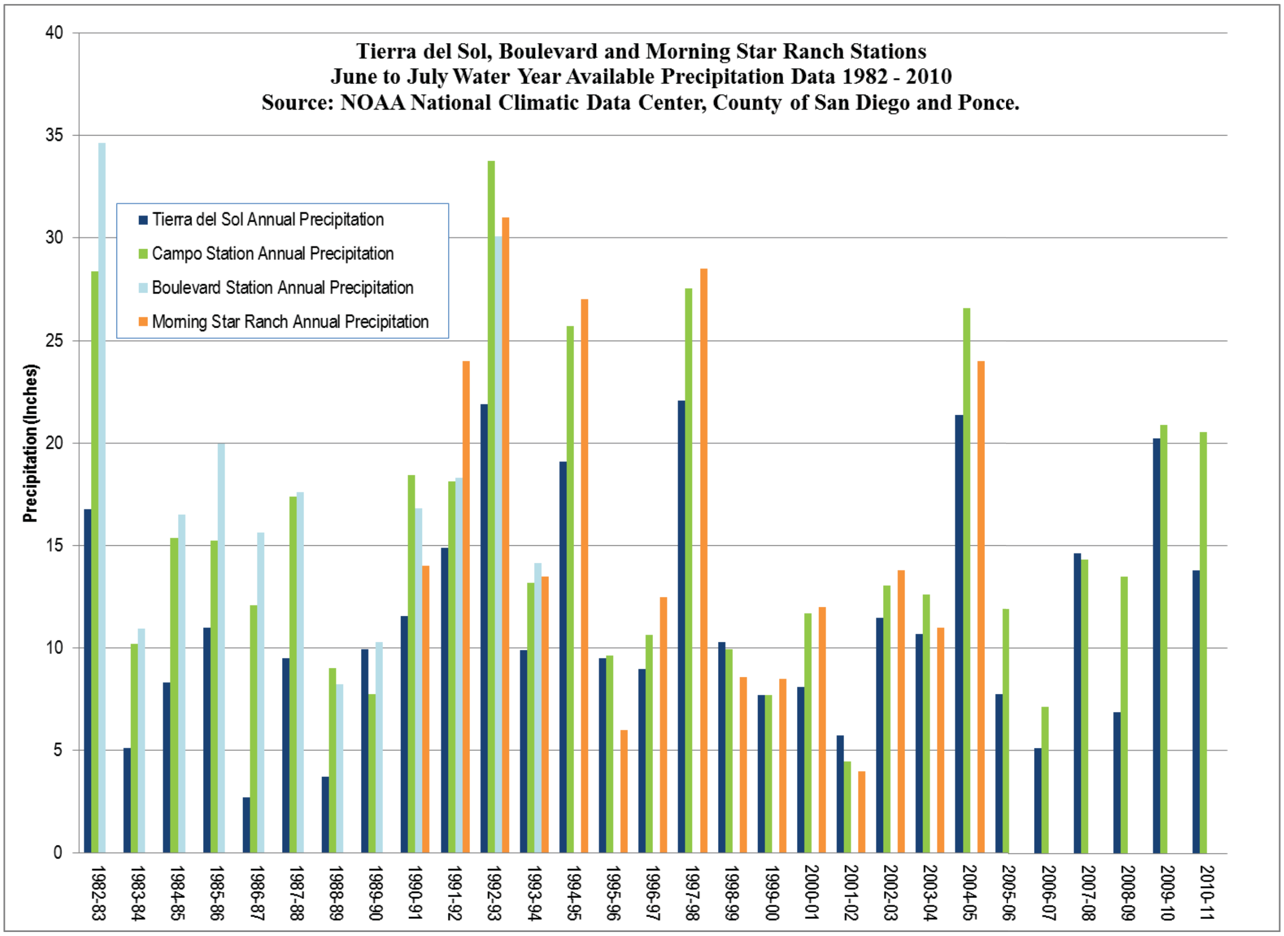
Notes: Station located at N 32°39', W 116°19' at an elevation of 4,000 feet.

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



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

Exhibit 2-D
Water Year Precipitation Data 1982 to 2012



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

Table 2-4
CIMIS Zone 16 Reference Evapotranspiration

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

Source: CIMIS 1999

2.3 Land Use

The Project site is predominantly undeveloped, though several unpaved roads cross the site, and there are small buildings (cabins and ranch bunkhouse) and graded areas associated with a non-operational rural air field in the north-central building block. According to the San Diego County General Plan, the Project site is located within the Mountain Empire Subregional Plan Area and the land use category for the Project site is Rural Lands (RL) with a permitted density of 1 dwelling unit per 80 acres (RL-80). The area is zoned General Rural (S92). The site is characterized by gently sloping hillsides and shallow valleys, with rock outcrops and a few small hills scattered throughout. The Phase I report for the Project indicates that the Project site is currently used as grazing land and has been used for agricultural grazing since at least 1953 (AECOM 2012a). The Project site also includes a stock pond, water wells, a man-made reservoir in the central and northwestern portions of the site, and a SDG&E construction laydown area associated with construction of the Sunrise Power Link 500kV high voltage overhead power line located in the northeast portion of the site west of McCain Valley Road.

The County of San Diego Draft Land Use Update depicts land use surrounding the Project as predominantly rural lands (RL-20, RL-40 and RL-80; see Figure 5). Additional land use designations in the vicinity of the Project include tribal lands consisting of the Campo, Manzanita, and LaPosta reservations to the west; semi-rural residential (SR-4), rural commercial, village residential (VR-7.3), and public/semi-public facilities associated with the community of Boulevard located south of I-8; and public open space to the west and northwest. In addition, a low-security detention facility (McCain Conservation Camp) is located to the southeast.

2.4 Project Water Demand

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

2.4.1 Construction Water Demand

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

The peak construction water demand will occur over a period of approximately 60 working days when the site will be cleared, grubbed, and graded. The daily estimated water demand over the 60-day period ranges from 192,000 gpd to 296,000 gpd (AECOM 2013). After the site has been cleared and graded, a soil tackifier such as Envirotac II or similar will be applied to the prepared surfaces of the site to stabilize soils. The Envirotac II will last up to 18 months without reapplication. After application of the tackifier, it is anticipated that 18,000 gpd of water will be required, on average, for dust control for areas being actively used (e.g., access roads, equipment and vehicle staging areas, etc.) for the remainder of the Project construction.

The Project construction is expected to last approximately 1 year. The expected water demands by workday are provided in Table 2-5. The water estimates provided in Table 2-5 are inclusive of the following activities:

- clearing, grubbing and grinding over 40 working days at the start of construction;
- mass grading over nine working days;
- concrete mixing associated with tracker foundations distributed over each of the four tracker installation phases;
- and ongoing dust control requirements, including additional dust control when winds exceed 15 MPH

Table 2-5
Construction Water Demand

Month	Day 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	WD	Working Days: Total Per Month	Total Demand: K gallons Per Mo.	Total Demand: Acre-feet Per Mo.	Groundwater: On-Site	Groundwater: Off-Site
Water Demand in Thousands of Gallons (K gallons)																																					
2014																																					
July												296	296		296	296	296	296	296	296		296	296	296	296	296	296		296	296	296	81	17	5,119	15.7	9	7
August	296	296	296		296	296	296	296	296	296		296	296	296	296	296	296		296	296	296	296	296	296		296		296	192	192	196	81	26	7,478	23.0	14	9
September		196	196	196	196	196	196		22	22	22	22	22	22		22	22	22	22	22	22		22	22	22	22	22		22	22		81	25	1,678	5.2	5	0
October	22	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	81	27	549	1.7	2	0
November	18		18	18	18	18	18	18		22	22	22	22	22	22		22	22	22	22	22	22			22	22	22	22	22	22		81	25	604	1.9	2	0
December	8		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18	18			18	18		12	12	12	81	25	503	1.5	2	0
2015																																					
January		12	12		22	22	22	22	22	22		22	22	22	22	22	22		22	22	22	22	22	22		22	22	22	22	18	18	81	26	626	1.9	2	0
February		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18				81	24	513	1.6	2	0
March		18	18	18	18	18	18		18	22	22	22	22	22		22	22	22	22	22	22		22	22	22	22	22	22		22	18	81	26	622	1.9	2	0
April	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18		81	26	549	1.7	2	0
May	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		81	26	549	1.7	2	0
June	18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18	18	18	18	18		18	18		81	26	549	1.7	2	0
July	18																																1	18	0.1	0	0
2014 Total																																**732**	**145**	**15,933**	**49**	**33**	**16**
2015 Total																																**244**	**155**	**3,428**	**11**	**11**	**0**
PROJECT TOTAL																																**976**	**300**	**19,361**	**59**	**44**	**16**

Activity
- = Clearing, Grubing, Grinding and Dust Control
- = Mass Grading and Dust Control
- = Concrete Work
- = Daily dust control only
- = Non-calendar day
- = Sunday/Holliday

Notes: Water demand estimates include 4,040 gallons per day of water required for concrete work over 90 days, split proportionally (based on no of trackers) across four tracker installation phases. Wind day demand was estimated based on the number of days where average wind speeds exceeded 15 MPH at the Campo station in 2012 (22 days) Based on 300 construction days out of 365 day calendar year this works out to 19 wind days. The associated water requirement was split evenly across the months during which construction would occur.
WD = Wind Day Demand (Additional dust abatement required when winds exceed 15 MPH).

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Considering the nature and phasing of these activities, the total construction water demand is expected to be approximately 19.4 million gallons, or 59 acre-feet.

On-site Wells 6a, 6b and 8 are limited to a combined capacity of 127 gallons per minute (gpm) or 182,880 gpd. Existing use of Well 6a is 6,600 gpd for operations at Rough Acres Ranch. Additionally, Tule Wind Project O&M is estimated to use 2,500 gpd from Well 6a. Considering existing use of Well 6a for the Rough Acres Ranch and O&M needs for the Tule Wind Project, which is expected to be built by the time Rugged begins construction, it is estimated that approximately 173,780 gpd would be available from the three wells for construction-related use. Given these limitations, on-site water use from Wells 6a, 6b and 8 together are assumed to supply groundwater at a maximum rate of 14 acre-feet per month in the beginning of the construction period, decreasing to less than 2 acre-feet per month thereafter. The total on-site groundwater demand during project construction is approximately 44 acre-feet. Early in the construction period, approximately 16 acre-feet of groundwater will need to be supplied from off-site sources.

2.4.2 Operational Water Demand

The highest operational water demands are anticipated to occur during CPV panel washing and application of a non-toxic soil binder to stabilize site soils. Panel washing, which would occur approximately nine times per year by mobile crews, will be undertaken using a tanker truck and smaller "satellite" panel washing trucks. On-site water storage tanks will be installed to facilitate washing and to support fire suppression. Each panel washing truck will carry water treatment equipment and truck-mounted panel washing booms. Water will be treated to ensure a hardness level of 7 milligrams per liter (mg/L) or less and to remove impurities. Wastewater from water conditioning not used for panel washing will be captured and disposed of off-site. As a conservative estimate, approximately 24 gallons of water will be required to wash each set of tracker modules for a total of 775,008 gallons per year or 2.4 afy.

It is anticipated that the soil stabilizer chosen for the project would need to be reapplied annually. The project would utilize a soil binding stabilization agent that is nontoxic and permeable. The purpose of the soil stabilizer is to prevent erosion and to reduce fugitive dust. Reapplication of the soil stabilizer agent requires approximately 3,300 gallons of water per acre. Approximately 254 acres, consisting of O&M building areas, substation, fire and service roads, will be surfaced with decomposed granite requiring annual soil stabilizer application. Thus, the annual water demand for soil binder application is anticipated to be approximately 838,200 gallons, or 2.6 acre-feet.

Sanitary and drinking water needs associated with the O&M building would require approximately 125,664 gallons per year (or 0.4 afy), based on an average monthly water usage of 10,472 gallons. The proposed landscape vegetative screen would require 508,328 gallons per year or 1.56 afy. A contingency of 1.8 afy has been included in the operational water demand should additional water be required to meet Project demand.

To meet operational water demand, the Project is expected to require up to 2.9 million gallons or 8.7 afy as shown in Table 2-6. For the purpose of the groundwater analysis in this report, it is assumed that the operational water demands of the project would be entirely met using production from the on-site water production wells (Wells 6b and 8).

Table 2-6
Operational Water Demand

Application of Soil Binder (if required)	
Number of gallons/acre/year[1]	3,300
Acres[2]	254
Water use/year – gallons (acre-feet)	838,200 (2.57) [3]
Tracker Washing	
Washes/year	9
Number of trackers	3,588
Gallons/tracker/wash (maximum)	24
Total tracker water use/year – gallons (acre-feet)	*775,008 (2.38)*
Potable Water Needs	
Amount of Potable Water usage per year [4] – gallons	125,664 (0.38)
Landscape Vegetative Screen	
Water use/year – gallons (acre-feet)	508,328 (1.56)
Contingency	
Water use/year – gallons (acre-feet)	587,704 (1.8)
Total Water Use Per Year	***2,834,904 gallons/ 8.7 acre-feet***

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

2.4.3 Amortize Construction Water Use with Operational Use

In order to determine whether the Project is required to complete a Water Supply Assessment (WSA) in accordance with California Water Code (CWC) Section 10912(a)(5)(B), the Project construction water use is amortized over a 20-year period, which is the period that WSAs are required to review. No WSA is required unless the facility qualifies as a "project." CWC Sec. 10912(a)(5)(B) defines what a "project" is for solar and wind projects. It states that a "proposed photovoltaic or wind energy generation facility approved on or after the effective date of the amendments made to this section at the 2011–2012 Regular Session is not a project if the facility would demand no more than 75 acre-feet of water annually." The water demand for the 1 year construction period is 59 acre-feet, and the annual water demand for operation is approximately 8.7 acre-feet. Therefore, over a 20-year period the Project will use 224 acre-feet or 11 afy amortized over 20 years. As the Project will demand less than 75 acre-feet of water annually amortized over the 20-year period, a WSA is not required.

2.5 Geology and Soils

The Project is located on the eastern portion of the Peninsular Range geomorphic province which is a series of northwest-oriented mountain ranges separated by northwest trending valleys, subparallel to faults branching from the San Andreas Fault. Regionally, the trend of topography is similar to the California Coast Ranges, but the geology is more like the Sierra Nevada, with granitic rock intruding older metamorphic rocks. As shown in Figure 6, the Project area is underlain by Cretaceous plutonic rocks of the composite Peninsular Ranges Batholith, namely consisting of a bedrock unit known as the Tonalite of La Posta (also referred to as the La Posta Quartz Diorite) (USGS 2004). The bedrock unit is topographically expressed by low hills, valleys, and undulating topography atop an elevated highland, which includes the McCain Valley north of I-8, and the Campo Valley southwest of I-8. The Tecate Divide—a subtle NNE-trending ridge within the Tonalite of La Posta—separates drainages that discharge toward the Salton Sea from drainages that discharge toward the Pacific Ocean via the Tijuana River.

Generally, the Tonalite of La Posta is weathered near the surface and supports a sandy topsoil. At a regional scale, the granitic rock preferentially weathers along fractures/lineaments in the landscape created by near-vertical tubular bodies of rock up to 0.5 mile thick (USGS 2004). This structure has a tendency to create hills and stream valleys oriented roughly parallel to the outer boundary of the batholith. Regionally, the Tonalite of La Posta is bounded to the west and north by higher mountainous peaks (e.g., Laguna Mountains) consisting of a mix of uplifted plutonic and ancient metamorphic rock. Further to the east and northeast, canyons lead out of the mountainous highlands, through older metamorphic rocks, into broader alluvial valleys on the western side of the Salton Trough and within the Anza Borrego State Park and Carrizo Plain regions.

The type, aerial extent, and some key physical and hydrological characteristics of soils mapped near the Project site were identified based on a review of soil surveys completed by the USDA, Natural Resources Conservation Service (NRCS) (NRCS 2012). Soil units are shown in Figure 7 and are described in Table 2-7.[1] Approximately 14% of the proposed Project site is underlain by deeper alluvial soils (*Lu*) associated with Tule Creek; these soils, along with the Tollhouse rocky coarse sandy loam (*ToE2*) and rock outcrops (*AcG*) belong to Hydrologic Groups C and D (higher runoff potential), primarily as a result of a higher fraction of silt and clay (for the alluvial soils), or because of the shallow depth to a restrictive layer (for the Tollhouse soil and rock outcrops). These conditions cause a higher portion of precipitation to be conveyed as runoff compared to deep, highly-permeable soils.

Table 2-7
Soil Units within the Rugged Solar Farm Footprint

Map Unit, Soil Name	Acres (Percent of the Project Site)	Parent Material	Depth to restrictive layer (inches)	Hydrologic Group[a]	Erosion Factor [b]
LcE2, La Posta rocky loamy coarse sand	518 (68%)	Residuum weathered from granodiorite	20–40	B	0.15–0.24
Lu, Loamy alluvial land	103 (14%)	Residuum weathered from calcareous sandstone and shale	> 60	C	0.37–0.49
MvC, Mottsville loamy coarse sand	96 (13%)	Alluvium derived from granite	> 60	A	0.20–0.24
ToE2, Tollhouse rocky coarse sandy loam	13 (2%)	Residuum weathered from granodiorite	5–20	D	0.15
KcC, Kitchen Creek loamy coarse sand	15 (2%)	Residuum weathered from granodiorite	40–60	B	0.17
CaB, Calpine Coarse Sandy Loam	12 (2%)	Alluvium derived from granite	> 60	B	0.15-0.24
AcG, Acid igneous rock land	4 (1%)	Acid igneous rock	0–4	D	—

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: NRCS 2012

1 Note: Figure 7 shows soils within a 0.5 mile radius of wells 6b and 8, whereas Table 2-7 presents acreages of each soil unit within the footprint of the proposed Rugged Solar Farm.

2.6 Hydrogeologic Units

Three hydrogeologic units are mapped within the Project area, including recent alluvium, and both the weathered and un-weathered components of the Cretaceous Tonalite of La Posta. The alluvium is directly underlain by the Tonalite of La Posta, which is also exposed as outcrops throughout the watershed. The weathered component of the bedrock is also referred to as decomposed granite (DG), and the underlying crystalline bedrock is extensively fractured and appears to be the most substantial aquifer in the region.

Boring logs were obtained for several of the existing on-site wells and for wells within the vicinity of the Project. On-site wells associated with the Project consist of a new production well (Well 6b) and an existing well (Well 8), which was deepened. Other wells in the vicinity are used by rural residences, Indian reservations, the McCain Conservation Camp, and the Rough Acres Foundation. The subsurface lithology and description of hydrogeologic units are based on well logs completed as part of this investigation and additional data obtained from a groundwater investigation completed by Geo-Logic Associates for the Tule Wind Project and the Rough Acres Ranch Campground Project (GLA 2012a, 2012b).

Alluvium: Alluvium in the region and in the vicinity of Wells 6b and 8 is primarily associated with the Tule Creek corridor and its tributaries. Figure 6 shows the alluvium in the center of the McCain Valley along Tule Creek, and the alluvial land (*Lu*), the Mottsville (*MvC*), and Calpine (*CaB*) soil units, as shown in Figure 7, all consist of alluvium derived from granitic rock. These units approximate the aerial extent of recent alluvium in the Project area. Well 6a is located in an area mapped as alluvial land (*Lu*), and geologic information suggests that the alluvial deposits are approximately 70 to 80 feet thick (GLA 2012a). The California Department of Water Resources (DWR) well completion report for Well 8 (mapped within Calpine soil) identifies alluvial material extending to a depth of about 12 feet. The depth and presence of alluvium within any one place in the project area is variable, but is at its thickest toward the center of the McCain Valley, reaching a maximum of approximately 70 to 80 feet below ground surface (bgs) and pinching out toward to outer margins of the valley and upstream of tributary streams.

Decomposed Granite (DG): Weathered bedrock consisting of DG occurs beneath the alluvium, where present, and at the ground surface elsewhere. Based on well completion reports available from the DWR, decomposed granite for Well 6a and Well 8 extends to a depth of 230 and 310 feet bgs, respectively.

Granitic Bedrock: The crystalline bedrock is predominantly composed of tonalite. It is extensively fractured as evidenced by regional lineaments that trend both northwest–southeast and west–east as depicted on the interferometric synthetic aperture radar (IFSAR) digital ortho-photography (Figure 8).

A conceptual hydrogeologic cross section through the Rugged site has been produced using reported lithology from on-site Well 6 and 6a and off-site Well 4, as depicted in Figure 9 (GLA 2012a).

2.7 Hydrogeologic Inventory and Groundwater Levels

Seven water wells currently exist on the Project site and are associated with ranching, agricultural and recreational activities. Five additional wells exist off site that are associated with Rough Acres Ranch. Twenty-four unique confidential well logs were identified in the vicinity of the Project site. The location of on-site and off-site wells is depicted in Figure 10, and well information including groundwater levels is provided in Table 2-8. Confidential well logs are not correlated with mapped well locations. County well permits by parcel and developed rural residential parcels are depicted in Figure 10.

Well depths for on-site wells range from 170 to 480 feet bgs. It should be noted that several borings have been drilled on Rough Acres Ranch up to 970 feet bgs. Deep borings in Wells 6b and 8 encountered water bearing fractures. Collapse of the formation borewall, however, prevented installation of Wells 6b and 8 to the total depth of the drilled borings. Well yields for on-site wells range from 0.5 to 60 gpm with an average well yield of approximately 34 gpm. On-site wells are completed in alluvium, DG, and fractured granitic bedrock as discussed in Section 2.6.

Depths for off-site wells range from 85 to 890 feet bgs. Well yields for off-site wells range from 1.5 to 100 gpm with an average well yield of approximately 23 gpm. Off-site wells are predominantly completed in DG and fractured granitic bedrock. The DG/bedrock contact is reported to range from 5 to 480 feet deep with an average depth of 90 feet bgs.

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

Well Number	Well Completion Depth (feet bgs)	Depth to Water (feet bgs);date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Decomposed Granite (DG) (feet bgs)	Fractured Granite (feet bgs)
On-site Wells						
Well 6	295	16.12;1/31/2013	60	NA	NA	NA
Well 6a	385	16.18;1/8/2013	50	0-70	70-230	230-420
Well 6b	480	14.7;1/31/2013	50	0-60	60-198	198-680

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

Well Number	Well Completion Depth (feet bgs)	Depth to Water (feet bgs);date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Decomposed Granite (DG) (feet bgs)	Fractured Granite (feet bgs)
Well 8	376	16.3;1/16/2013	27[b]	0-12	12-310	310-970
Well 8a	170	27.4;1/31/2013	15	0-12[e]	12-260	NA
Well 9	NA	14.38;1/31/2013	<0.5	NA	NA	NA
Old Ag Well	NA	14.2; 1/31/2013	NA	NA	NA	NA
Rough Acres Ranch Off-site Wells						
Well 1	150	27.35;1/31/2013	10	0-2	2-15	15-178
Well 2	185	28.25;1/31/2013	6	0-2	2-15	15-178
Well 3	890	12.79;1/31/2013	NA	NA	NA	NA
Well 4	185	17.46;1/31/2013	10	0	0-91	91-260
Well 5	NA	NA	NA	NA	NA	NA
Off-site Confidential Well Log Summary[a]						
Conservation Camp Well 1	NA	NA	NA	NA	NA	NA
2419	399	NA	15	NA	NA	NA
2420	260	30; 12/7/1985	18	0	0-110	110-260
2787	260	30; 1/25/1989	10	0-18	18-140	140-260
3237	580	60; 6/19/1979	20	NA	0-5	5-580
4700	220	5; 5/17/1978	25	0-5	5-10	10-220
5033	320	100; 8/10/1971	10	0	0-13	13-320
5581	210	20; 4/3/1972	20	NA	NA	NA
6759	460	95; 11/25/1977	1.5	0-2	2-10	10-460
6924	240	30; 11/24/1987	12	0-2	2-50	50-240
9119	330	Na; 3/15/1990	5	0-15	15-60	60-330
10107	360	25; 5/28/1979	8	0-15	15-27	27-360
11104	185	16; 3/6/1986	12	0-3	3-29	29-185
11105	105	7; 2/1/1980	42	0-16	16-105	NA
11106	320	30; 4/3/1984	14	0-16	16-65	65-320
11190	365	40; 4/13/1986	14	0	0-38	38-365
11496	280	2; 6/22/1981	8	0-42	0-42	42-280
15265	500	20; 2003	14	0-2	2-16	16-500
16457	850	28; 2/14/05	10	0-6	6-62	62-850
16631	780	NA	15	0-2	2-17	17-780
17532	500	NA	42	0	0-20	20-500
18948	280	10; 5/21/1985	30	0-23	23-120	120-280
20811	616	72; 5/4/2011	100[d]	0-4	4-430	430-616

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

Well Number	Well Completion Depth (feet bgs)	Depth to Water (feet bgs);date	Approximate Production Capability (gpm)	Alluvium/ Residual Soil (feet bgs)	Decomposed Granite (DG) (feet bgs)	Fractured Granite (feet bgs)
20814	810	40; 5/9/2011[c]	55	0-6	6-480	480-810
20912	566	70; 5/10/2011	100[d]	0-3	3-360	360-566

[a] Confidential well logs are not correlated with the mapped well locations.
[b] Well 8 was originally drilled to 970 feet bgs with a water producing fracture encountered at 961 feet bgs that produced 40 gpm during airlifting. Well 8 was completed to a depth of only 376 feet bgs due to a collapsed borehole. Well 8 airlifted 50 gpm during drilling.
[c] Water level reported in Drilling/Destruction Report Well Site No. 1 United States Border Patrol – Boulevard Station (Dudek 2011a).
[d] The approximate production capability is approximately 1/3 the airlifted rate reported on the well logs as reported in Groundwater Well Testing and Analysis Report for Wells No. 2 and No. 3 United States Border Patrol – Boulevard Station (Dudek 2011b).
[e] Well 8a alluvial thickness inferred from Well 8 log.

NA= not available

2.8 Water Quality

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

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

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

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

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

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3.0 WATER QUANTITY IMPACT ANALYSIS

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

3.1 50% Reduction of Groundwater in Storage

Due to limited project area and the relatively small water requirement of the Project compared to the volume of groundwater in storage within the McCain Hydrologic Subarea, an analysis was performed for the two areas surrounding the proposed supply Wells 6a and 6b, and Well 8, extending out to a 0.5 mile radius, as per consultation with the County Groundwater Geologist. The 0.5 mile radius areas surrounding the pumping wells each comprise 502 acres (as shown in Figure 10).

3.1.1 Guidelines for Determination of Significance

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

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

A project-specific soil moisture-based water balance analysis was performed. The analysis evaluates whether the construction and subsequent operational water demands for the Project maintain at least 50% groundwater in storage over the two 502 acre project groundwater resource areas after 30 years, including 1 year of Project construction and 29 years of Project operation.

3.1.2 Methodology

A soil moisture balance method was used to evaluate rainfall recharge within the 502-acre groundwater resource study areas surrounding Wells 6a and 6b, and Well 8 (Figure 10). The calculation assumes that no net flow of groundwater into or out of the 0.5 mile radius study areas from larger distances in response to local groundwater pumping drawdown. Rainfall, runoff, evapotranspiration, and groundwater recharge was calculated in monthly intervals using historical rainfall data for a span of 30 years, which includes periods of elevated rainfall and drought. Pumping-induced changes to the volume of groundwater in storage over the 30 year period within the 0.5 mile study areas were evaluated for the scenarios described in Section 3.1.2.2 and Section 3.1.2.3. By comparing the cumulative depletion in storage to the maximum volume of water potentially available as groundwater storage, a determination as to whether the 50% reduction significance threshold occurs can be made.

The study areas were defined by the horizontal radial boundary of 0.5 mile around Wells 6a and 6b, and Well 8 (Figure 10). The aquifer storage capacity is defined based on the currently estimated aquifer saturated thickness per hydrologic unit. For the groundwater production area surrounding supply Wells 6a and 6b, the aquifer saturated thickness by hydrologic unit is assumed to be 20 feet for alluvium, 10 feet for DG, and 500 feet for fractured rock. For the groundwater production area surrounding pumping Well 8, the aquifer saturated thickness by hydrologic unit is assumed to be 10 feet for alluvium, 10 feet for DG, and 500 feet for fractured rock. These values were derived from previous estimates of saturated thicknesses used to calculate groundwater in storage associated with the Tule Wind Project (GLA 2012a).

3.1.2.1 Groundwater Recharge

Groundwater recharge for the 0.5 mile study areas surrounding Wells 6a and 6b and Well 8 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), 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 to the total estimated groundwater in storage.

Data Compilation

The data required to provide groundwater recharge estimates were obtained from various sources and are discussed below.

Precipitation

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

Evapotranspiration

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

Soil Moisture Capacity

Soil moisture capacity or water-holding capacity is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point (USDA 1973). Soil water-holding capacity is dependent on the soil type and site-specific soil properties, including rock fragments, organic matter, bulk density, osmotic pressure, texture, and rooting depth (USDA 1998). The United States Department of Agriculture (USDA) has defined a range of water-holding capacity values for each type of soil present in San Diego County (USDA 1973). The mean value of the reported range of values for each soil type was used as the soil moisture capacity for this analysis. Soil type and coverage on the Project site were provided by SanGIS based on the USDA mapping (Figure 7). Mean water holding capacity by soil type is provided in Table 3-1 and Table 3-2.

Runoff

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

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

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

The monthly precipitation data used is the 30-year period (1982–2012) of record for the Tierra del Sol gauging station provided by the County of San Diego (Rand, pers. comm. 2012). The maximum soil moisture retention (S) is a function of soil type, with all soils having been classified into one of four hydrologic groups, A through D. Soils are classified by the USDA's NRCS into four hydrologic soil groups based on the soil's runoff potential. Group A soils generally have the smallest runoff potential and highest infiltration rates. Group D soils have the greatest runoff potential, lowest infiltration rates, and lowest soil moisture retention. The soils within the 0.5-mile radius surrounding Wells 6a and 6b fall into hydrologic groups A (68.5%), B (20%), C (10%) and D (1.5%) as shown in Table 3-1. The soils within the 0.5-mile radius surrounding Well 8 fall into hydrologic groups A (74%) and B (26%), as shown in Table 3-2.

Table 3-1
Well 6A/6B 0.5 Mile Radius Soil Types and Soil Moisture-Holding Capacities

Soil Symbol	Soil Name and Description	Hydrologic Soil Group	Soil Water Holding Capacity (inches)	Mean Soil Water Holding Capacity (inches)	Area (Acres)	Percent of Total Area Examined
AcG	Acid Igneous Rock Land	D	0.1	0.1	7.62	1.5%
LcE2	La Posta rocky loamy coarse sand, 5%–30% slope, eroded	A	1–2	1.5	178.94	35.7%
MvC	Mottsville loamy coarse sand, 2%–9% slope	A	4–5	4.5	113.31	22.6%
Lu	Loamy Alluvial Land	B	6-9	7.5	97.44	19.4%
ToE2	Tollhouse rocky coarse sandy loam, 5% to 30% slope, eroded	C	1-2	1.5	52.37	10.4%
CaC	Calpine Coarse Sandy Loam, 5% to 9% slope	B	4.5-6	5.25	2.68	0.5%
LaE2	La Posta Loamy Coarse Sand, 5% to 30% slope, eroded	A	2-3	2.5	49.50	9.9%

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

Table 3-2
Well 8 0.5 Mile Radius Soil Types and Soil Moisture-Holding Capacities

Soil Symbol	Soil Name and Description	Hydrologic Soil Group	Soil Water Holding Capacity (inches)	Mean Soil Water Holding Capacity (inches)	Area (Acres)	Percent of Total Area Examined
CaB	Calpine Coarse Sandy Loam, 2% to 5% slope	B	4.5-6.5	5.5	42.29	8.4%
LcE2	La Posta rocky loamy coarse sand, 5%–30% slope, eroded	A	1–2	1.5	342.06	68.2%
MvC	Mottsville loamy coarse sand, 2%–9% slope	A	4–5	4.5	28.57	5.7%
Lu	Loamy Alluvial Land	B	6-9	7.5	75.24	15%
GoA	Grangeville Fine Sandy Loam, 0% to 2% slope	B	6-8.5	7.25	13.71	2.7%

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

The CNM requires the selection of a curve number based on a combination of soil conditions, land use (ground cover), and hydrologic conditions to assign a runoff factor to the area. These runoff factors, called runoff curve numbers (CNs), indicate the runoff potential of an area. The higher the CN, the higher the runoff potential (County of San Diego 2003). Based on a pasture/range land ground cover and fair hydrologic condition,[2] CNs selected for soil groups A, B, C and D are 49, 69, 79 and 84, 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. Calculations are provided in Appendix C.

The runoff calculated for the 0.5 mile radius around Wells 6a and 6b is approximately 16 inches over the 30 years simulation period, or 0.5 inches per year. Annual rainfall is approximately 11 inches per year. Thus the runoff is approximately 5% of the rainfall. The soil types within 0.5 mile of Well 8, allow for more infiltration than those within 0.5 miles of Wells 6a and 6b. The average annual runoff in the vicinity of Well 8 is approximately 0.4 inches, or approximately 4% of the average annual rainfall.

3.1.2.2 Well 6a and 6b Groundwater Production Area 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 uses.
2. Water demand of the existing uses combined with Project-related water demands.
3. Water demand of the existing uses, with Project-related water demands, assumed full build-out of General Plan land uses within 0.5 miles, and the planned expansion of the Rough Acres Ranch Campground.

[2] Defined as not heavily grazed, with a plant cover of 50 to 75 percent of the area.

Information on water use in these scenarios (other than the water demands of the Rugged Solar Farm) is primarily derived from groundwater resource investigations carried out in support of the Tule Wind Project and the Rough Acres Ranch Campground Project (GLA 2012a, GLA 2012b), and MUP P09-019 issued to Tule Wind, LLC (County of San Diego 2012).

Scenario 1 evaluates groundwater recharge based on the existing use by the Rough Acres Ranch, seven existing residences with an assumed water demand of 0.5 afy per residence, and a small existing poultry farm.[3] Additionally, water use for the approved Tule Wind Project of 56 acre-feet for construction and 2,500 gpd (2.8 afy) for O&M are considered under scenario 1 as shown in Table 3-3.

Table 3-3
Scenario 1—Wells 6a/6b Existing Conditions

Land Use	Quantity	Water Demand Per Unit	Total Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Single-Family Residential Units (7 residences, 0.5 afy per residence)	7	0.5 afy	3.50	105
Rough Acres Ranch Existing Condition	1	6,600 gpd	7.39	222
Poultry Raising (500 birds, 50 gallons per 500 birds per day, not operational)	-	-	0.06	2
Tule Wind Project Operations and Maintenance[a]	1	2,500 gpd	2.8	84
One-time Demand for Construction				
Tule Wind Project Construction[b]	1	56 acre-feet	56	56
Total Water Demand Under Scenario 1			**13.75**	**469[c]**

a Tule Wind Project O&M water use is estimated at 2,500 gpd and will be supplied form Well 6a.
b Tule Wind Project has been approved to use 56 acre-feet for construction phase of the project from Wells 6/6a and 8. Well 8 shall be further limited to a total of 20 acre-feet of groundwater for this project. For this analysis, the full allotment of 56 acre-feet has been apportioned to Wells 6a and 6b to simulate the maximum potential reduction in storage.
c Includes existing and Tule construction and operational water demands over 30 year period.
Source: GLA, 2012a (Tule Wind Groundwater Investigation Report) and County of San Diego, 2012 (MUP P09-019).

Scenario 2 evaluates groundwater recharge based on existing conditions in addition to the water use proposed by the Rugged Solar Farm Project. Water use for the proposed Project is based on the capacity of Wells 6a and 6b (approx. 100 gpm combined), assuming that they would operate at or near full capacity during the peak period of construction-related water demands. Allowance for existing demand of 6,600 gpd for ongoing O&M at Rough Acres Ranch, 2,500 gpd for O&M of the Tule Wind Project and 3,125 gpd for residential use from Well 6a has been factored into the available water supply scenarios. For the remainder of the construction period, and during

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

operation and maintenance of the solar farm, water demands are assumed to be shared between Wells 6a and 6b and Well 8. The water use considered under Scenario 2 is shown in Table 3-4.

Table 3-4
Scenario 2— Wells 6a/6b Existing and Proposed Project Conditions

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Yearly Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Condition (see Table 3-3)	--	--	13.75	413
Rugged Solar Farm O&M	--	--	6	174
One-time Demand for Construction				
Tule Wind Project Construction [a]	1	56 AF/ 9 months	56	56
Rugged Solar Farm Construction	--	--	32.7	32.7
Total Water Demand Under Scenario 2:			**20**	**676**[b]

[a] Total on-site groundwater demand for the Rugged Solar Project is 44 acre-feet of which 32.7 acre-feet has been assigned to Wells 6a and 6b.
[b] Includes one-time demands for Tule and Rugged construction.
Source: GLA, 2012a (Tule Wind Groundwater Investigation Report) and County of San Diego, 2012 (MUP P09-019).

Scenario 3 evaluates groundwater recharge based on Scenarios 1 and 2 in addition to other foreseeable future projects that could utilize Wells 6a and 6b. These projects include 1) construction and operation of the Rough Acres Ranch Campground Project, and 2) assumed full build-out of the general plan uses within 0.5 miles of the wells (four residences in addition to existing conditions). The water use considered under Scenario 3 is shown in Table 3-5.

Table 3-5
Scenario 3— Wells 6a/6b Existing and Proposed Project Conditions with Full General Plan Build-out

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Total Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Condition (see Table 3-3)	--	--	13.75	413
Rugged Solar Farm O&M	--	--	6	174
Rough Acres Ranch Campground Project O&M[a]	--	--	17.4	435
Additional Residential Water Users Under Full General Plan Build-out	4	0.5	2	60
One-time Demand for Construction				
Rugged Solar Farm Construction	--	--	32.7	32.7
Tule Wind Project Construction	1	56	56	56
Rough Acres Ranch Campground Project construction	--	--	0 - 17.3	32.47
Total Water Demand Under Scenario 3 :			**39**	**1,203**[a]

[a] Rough Acres Ranch Project O&M is evaluated over a 25 year period (2018-2042).
[b] Includes existing, Tule/Rugged/Rough Acres Ranch Campground construction and operational water demands over 30 year period plus general plan build-out.

3.1.2.3 Well 8 Groundwater Production Area Demand

Groundwater demand was evaluated for three scenarios:

1. Water demand based on existing uses.
2. Water demand of the existing uses combined with Project-related water demands.
3. Water demand of the existing uses, with Project-related water demands, and assumed full build-out of General Plan land uses within 0.5 miles.

Information on water use in these scenarios (other than the water demands of the Rugged Solar Farm) is primarily derived from groundwater resource investigations carried out in support of the Tule Wind Project and Rough Acres Ranch Campground Project (GLA 2012a, GLA 2012b), and MUP P09-019 issued to Tule Wind, LLC (County of San Diego 2012)..

Scenario 1 evaluates groundwater recharge based on the existing use by one existing residence with an assumed water demand of 0.5 afy per residence, and the McCain Valley Conservation Camp. Water demand for the McCain Valley Conservation Camp is an estimate based on water consumption indices provided by the American Water Works Association (GLA 2012a). The water use considered under scenario 1 is shown in Table 3-6.

Table 3-6
Scenario 1—Well 8 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	1	0.5	0.50	15
McCain Valley Conservation Camp (100 inmates; 120 gallons per person per day)	1	13.44	13.44	403
One-time Demand for Construction				
Tule Wind Project Construction[a]	1	20	20	20
Total Existing Water Demand Under Scenario 1:			**14**	**438[b]**

a For this analysis, 20 acre-feet was allocated to Well 8 for the Tule Wind project construction.
b Includes exiting and Tule construction and operational water demands over 30 year period.
Source: GLA, 2012a (Tule Wind Groundwater Investigation Report) and County of San Diego, 2012 (MUP P09-019).

Scenario 2 evaluates groundwater recharge based on the existing conditions in addition to the water use proposed by the Rugged Solar Farm Project. Water use for the proposed Project is based on the tested capacity of Well 8 (approx. 27 gpm), assuming that it would operate at full capacity during the peak period of construction-related water demands for the Rugged Project. For the remainder of the construction period, and during operation and maintenance of the solar farm, water demands are assumed to be shared between Wells 6a and 6b and Well 8, with the yearly demand being apportioned to Well 8 based on its contributing fraction of the total production capacity of all on-site wells. The water use considered under scenario 2 is shown in Table 3-7.

Table 3-7
Scenario 2— Well 8 Existing and Proposed Project Conditions

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Total Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Condition (see Table 3-6)	--	--	14	420
Rugged Solar Farm O&M[a]	--	--	8.7	252
One-time Demand for Construction				
Tule Wind Project Construction[b]	1	20	20	20
Rugged Solar Farm construction	--	--	12	12
Total Existing Water Demand Under Scenario 2:			**22.7**	**704[c]**

a Rugged Solar Farm O&M is calculated over 29 year period.
b For this analysis, 20 acre-feet was allocated to Well 8 for Tule Wind Project construction.
c Includes existing and Tule/Rugged construction and operational water demands over 30 year period.

Scenario 3 evaluates groundwater recharge based on Scenario 1 and 2 in addition to an assumed full build-out of the general plan uses within 0.5 miles of the well (four residences in addition to existing conditions) and anticipated use for construction activities on the Rough Acres Ranch. The water use considered under Scenario 3 is shown in Table 3-8.

Table 3-8
Scenario 3— Well 8 Existing and Proposed Project Conditions with Full General Plan Build-out

Land Use	Quantity	Water Demand Per Unit (acre-feet/year)	Total Water Demand (acre-feet/year)	Total Water Demand Over 30 Years
Existing Condition (see Table 3-6)	--	--	14	420
Rugged Solar Farm O&M[a]	--	--	8.7	252
Additional Residential Water Users Under Full General Plan Buildout	4	0.5	2	60
One-time Demand for Construction				
Tule Wind Project Construction[b]	1	20	20	20
Rugged Solar Farm construction	--	--	12	12
Rough Acres Ranch Campground Project construction	--	--	0 - 10.49	34.07
Total Existing Water Demand Under Scenario 3:			**25**	**798[c]**

a Rugged Solar Farm O&M is calculated over 29 year period.
b For this analysis, 20 acre-feet was allocated to Well 8 for Tule Wind Project construction.
c Includes existing, Tule/Rugged/Rough Acres Ranch Campground construction and operational water demands over 30 year period plus general plan build-out.

3.1.2.4 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 area within a 0.5 mile radius of Wells 6a and 6b and Well 8. By multiplying the acreage of the area within a 0.5 mile radius of Wells 6a and 6b and Well 8 (503 acres each) by the estimated specific yield and the saturated thickness for each hydrogeologic unit, the total groundwater in storage within the 0.5 mile study area was estimated. The estimated specific yields for each hydrologic unit were obtained based on County Guidelines; which are 10% for alluvium, 5% for residuum (DG), and 0.10% for fractured bedrock (County of San Diego 2007, 2010b).

For the analysis of the groundwater storage capacity for Wells 6a and 6b, the saturated thicknesses of the alluvium, DG, and fractured granitic rock were assumed to be uniform at 20 feet, 10 feet, and 500 feet, respectively. These values were estimated based on borehole logs in the Project area and the distribution of geology and soils within the 0.5 mile radius of Wells 6a and 6b (GLA 2012a). Based on these saturated thicknesses, the total groundwater in storage within the 0.5-mile study area around Wells 6a and 6b is estimated to be 1,506 acre-feet. By hydrologic unit, the alluvium, saturated DG, and fractured granitic rock storage is 1,004 acre-feet, 251 acre-feet, and 251 acre-feet, respectively.

For the analysis of the groundwater storage capacity for Well 8, the saturated thicknesses of the alluvium, DG, and fractured granitic rock were assumed to be uniform at 10 feet, 10 feet, and 500 feet, respectively. These values were estimated based on borehole logs in the Project area and the distribution of soils within the 0.5 mile radius of Well 8. Based on these saturated thicknesses, the total groundwater in storage within the 0.5-mile study area around Well 8 is estimated to be 1,004 acre-feet. By hydrologic unit, the alluvium, saturated DG, and fractured granitic rock storage is 502 acre-feet, 251 acre-feet, and 251 acre-feet, respectively.

These assumed values for saturated thickness are conservative because groundwater levels measured in the project area suggest that the saturated thickness of the alluvium and DG is greater, particularly for Wells 6a and 6b (see Section 2.6 and Figure 9). Using conservative values is appropriate, however, because the thickness of various hydrogeologic units within a 0.5 mile radius is likely to vary substantially.

3.1.2.5 Long-Term Groundwater Availability

The volume of groundwater in storage varies depending on the rate of recharge and the volume of water pumped from storage (water demand). Long-term groundwater availability over a 30 year period was evaluated using the calculated groundwater recharge, the estimated water demand detailed in six scenarios (described in Sections 3.1.2.2 and 3.1.2.3), and the total groundwater in storage within the 0.5 mile study area of each well as an initial condition (Section 3.1.2.4). In addition, the construction-related demands of the Tule Wind Project, Rugged Solar Farm and the Rough Acres Ranch Campground Project were incorporated into the analysis using knowledge of the proposed construction schedule for the projects as well as the production capacity of the subject wells. As discussed in Section 2.4, the Project has an estimated long-term annual water demand of 8.7 afy as well as a one-time/short-term project construction demand of 59 acre-feet, which will be extracted over a 1 year construction period. During this period, which includes approximately 60 days of high groundwater use for site preparation, grading, and dust control, the wells were assumed to operate at or near full capacity. The on-site construction-related groundwater demands shown in Scenarios 2 and 3 are less than the full 1 year construction demand of 59 acre-feet because the water needs of the Project during the 60 day peak demand period would exceed the capacity of the onsite wells, requiring a short-term import of water from off-site sources to make up the difference.

Excel spreadsheets showing the calculations of the 30 year study period are provided in Appendix C.

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 at both Wells 6a and 6b and Well 8 pumping areas, the volume of groundwater in storage remains above the 50% significance threshold over the 30 year period. The following presents the results of each groundwater demand scenario for Wells 6a and 6b, and for Well 8.

3.1.3.1 Well 6a and 6b

As discussed above, the total groundwater in storage within the 0.5 mile study area around Wells 6a and 6b is estimated to be 1,506 acre-feet. Exhibits 3-A, 3-B, and 3-C present the amount of groundwater in storage over a 30-year record of precipitation/recharge for Scenario 1, Scenario 2, and Scenario 3, respectively. As shown in Table 3-9, the minimum volume of groundwater in storage over the 30-year period was approximately 1,395 acre-feet, or 93% 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 1,300 acre-feet, or 86% 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 1,057 acre-feet, or 70% of the initial groundwater storage capacity.

Table 3-9
Groundwater in Storage by Scenario for Wells 6a and 6b

	Scenario 1a Existing Conditions	Scenario 1b Existing Conditions	Scenario 2a Existing Conditions with Project	Scenario 2b Existing Conditions with Project	Scenario 3a Existing Conditions with Project and General Plan Build-out	Scenario 3b Existing Conditions with Project and General Plan Build-out
Minimum (af)	1,395	1,427	1,300	1,349	1,057	1,165
Maximum (af)	1,506	1,506	1,506	1,506	1,506	1,506
Average (af)	1,468	1,484	1,437	1,461	1,217	1,399
Percent Minimum Groundwater in Storage Over 30-year Period	92.6	94.8	86.3	89.6	70.2	77.3

3.1.3.2 Well 8

As discussed above, the total groundwater in storage within the 0.5 mile study area around Well 8 is estimated to be 1,004 acre-feet. Exhibits 3-D, 3-E, and 3-F 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 3-10, the minimum volume of groundwater in storage over the 30-year period was approximately 908 acre-feet, or 91% 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 826 acre-feet, or 82% of the initial groundwater storage capacity. Scenario 3 is the most water-intensive, and results in a minimum volume of groundwater in storage over the 30-year period of approximately 774 acre-feet, or 77% of the initial groundwater storage capacity.

Table 3-10
Groundwater in Storage by Scenario for Well 8

	Scenario 1a Existing Conditions	Scenario 1b Existing Conditions	Scenario 2 Existing Conditions with Project	Scenario 2b Existing Conditions with Project	Scenario 3a Existing Conditions with Project and General Plan Build-out	Scenario 3b Existing Conditions with Project and General Plan Build-out
Minimum (af)	908	939	826	863	773	813
Maximum (af)	1,004	1,004	1,004	1,004	1,004	1,004
Average (af)	972	987	943	965	929	952
Percent Minimum Groundwater in Storage Over 30-year Period	90.5	93.5	82.2	85.9	77.1	80.9

Exhibit 3-A
Scenario 1—Well 6a/6b Existing Demand Groundwater in Storage

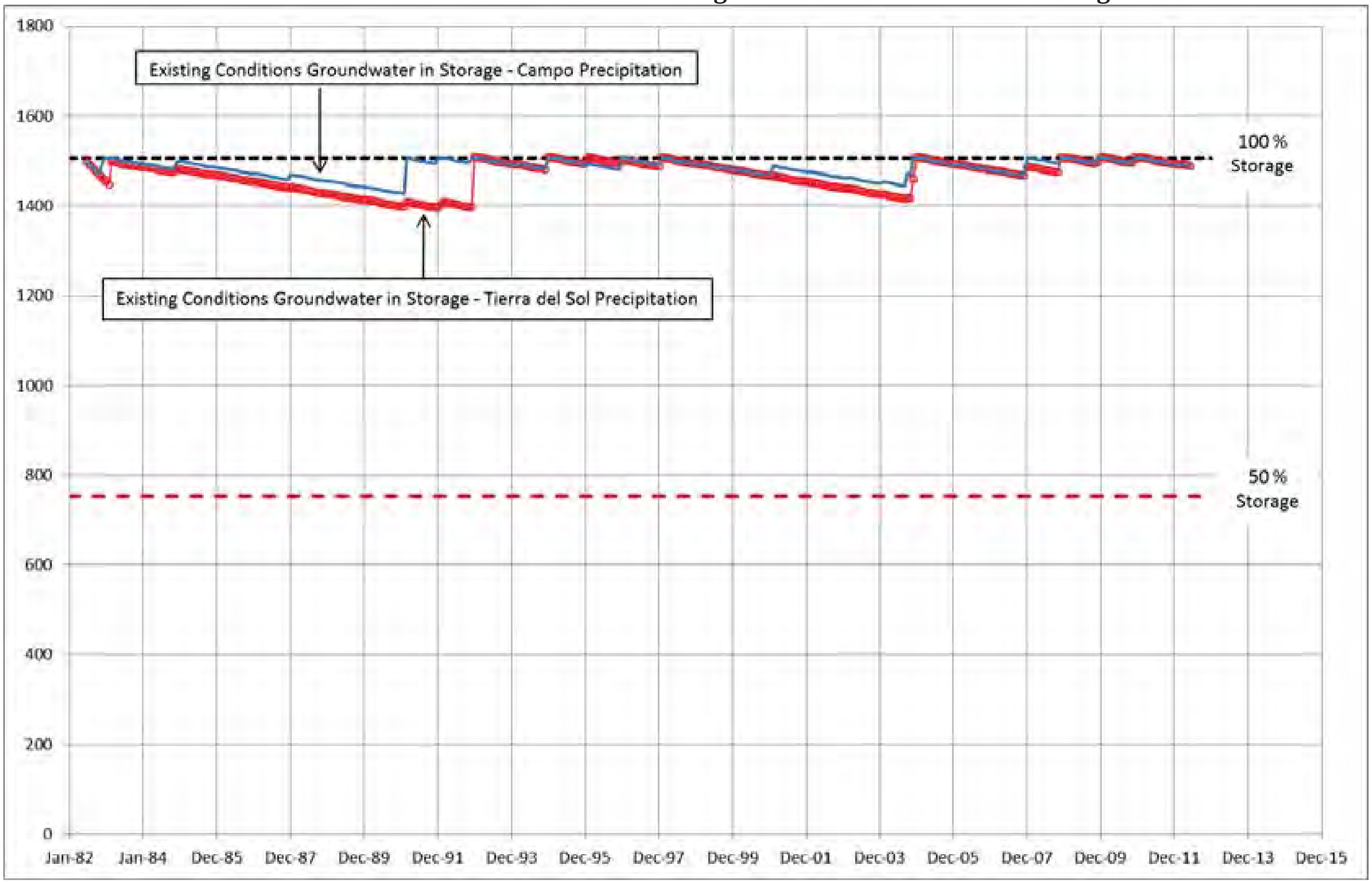


Exhibit 3-B
Scenario 2 - Well 6a/6b Existing and Project Demand Groundwater in Storage

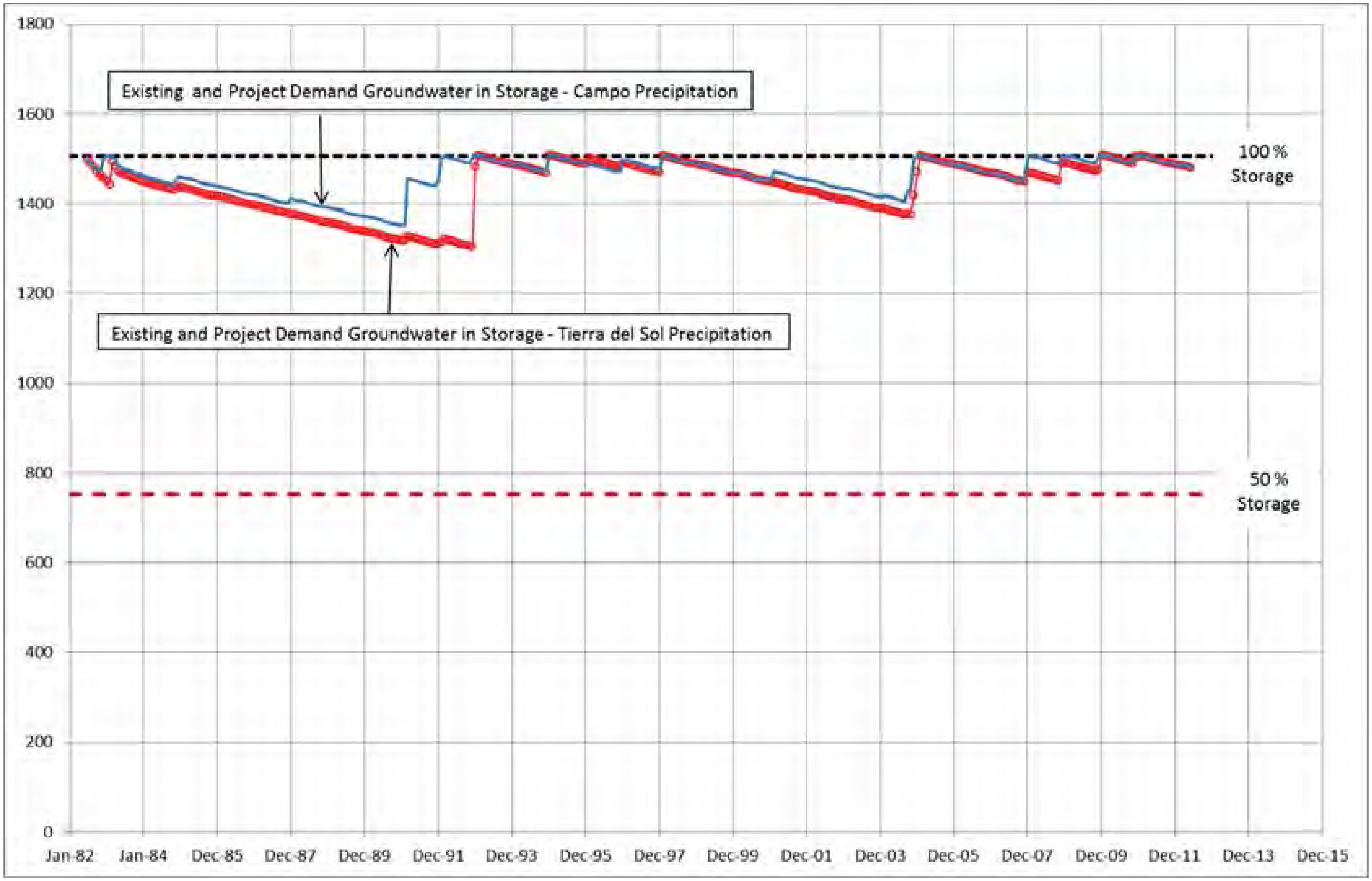


Exhibit 3-C

Scenario 3— Wells 6a/6b Existing and Proposed Project Conditions with RAR Campground, and Full General Plan Build-out

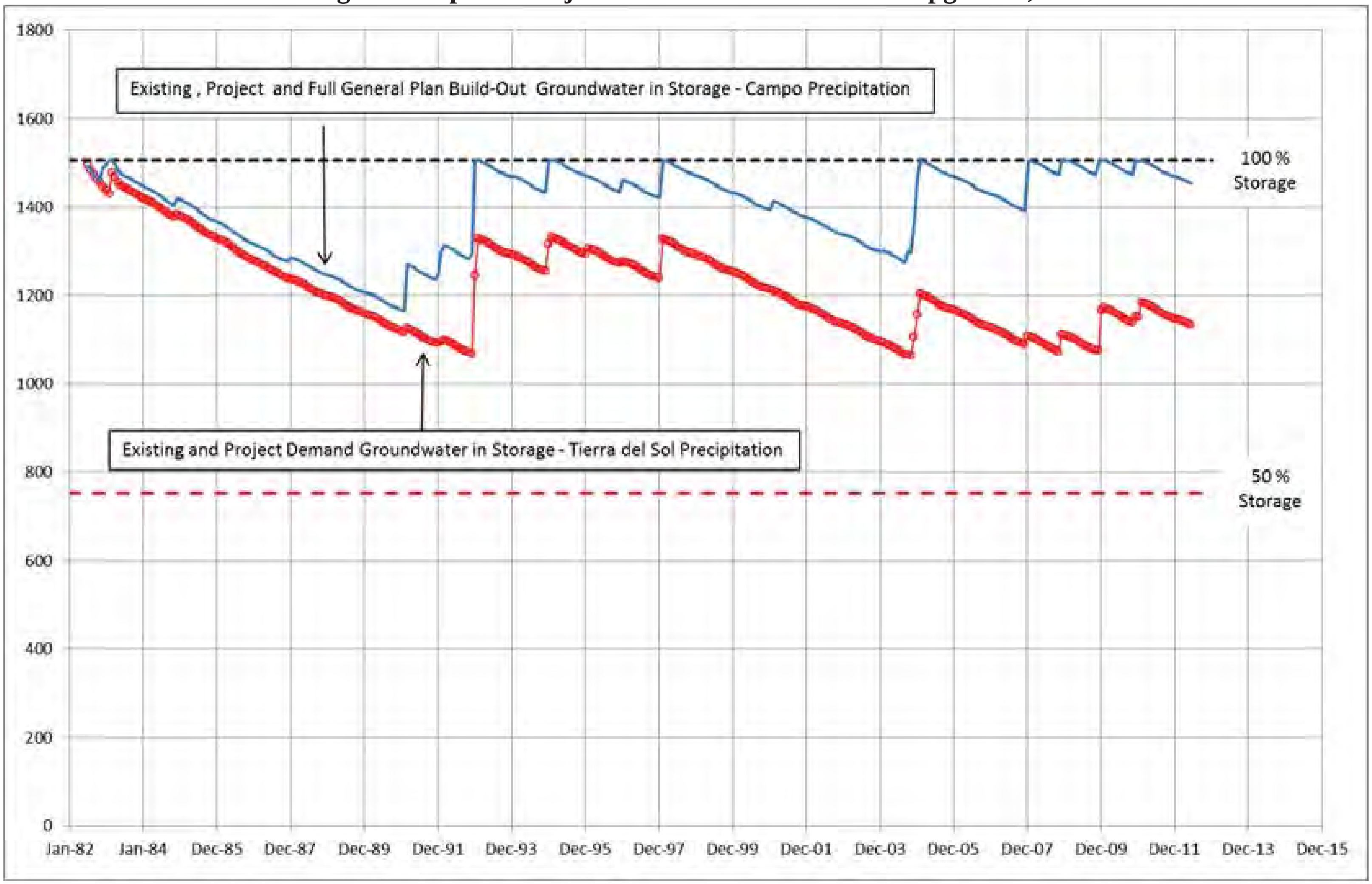


Exhibit 3-D
Scenario 1—Well 8 Existing Demand Groundwater in Storage

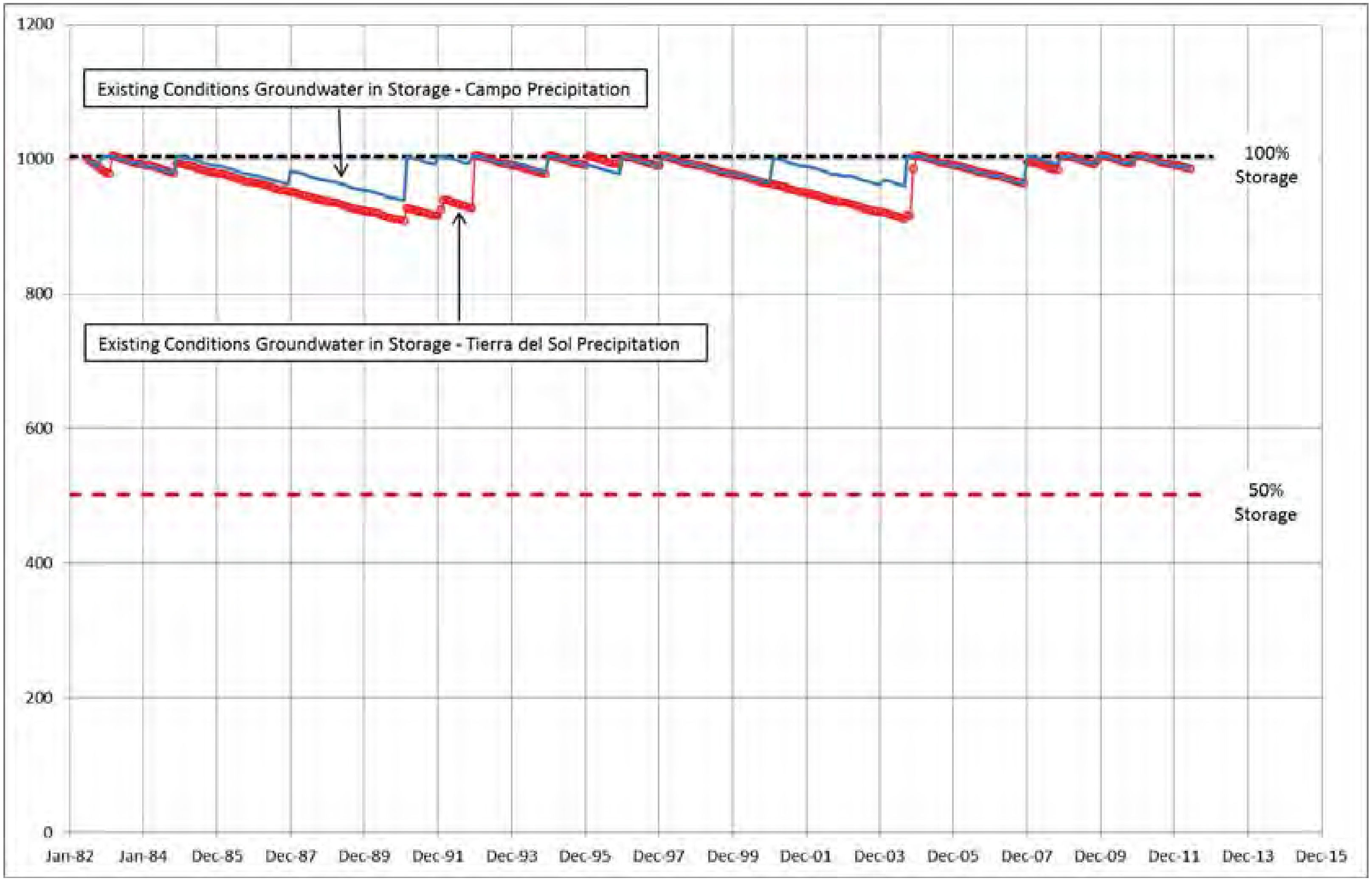


Exhibit 3-E
Scenario 2 - Well 8 Existing and Project Demand Groundwater in Storage

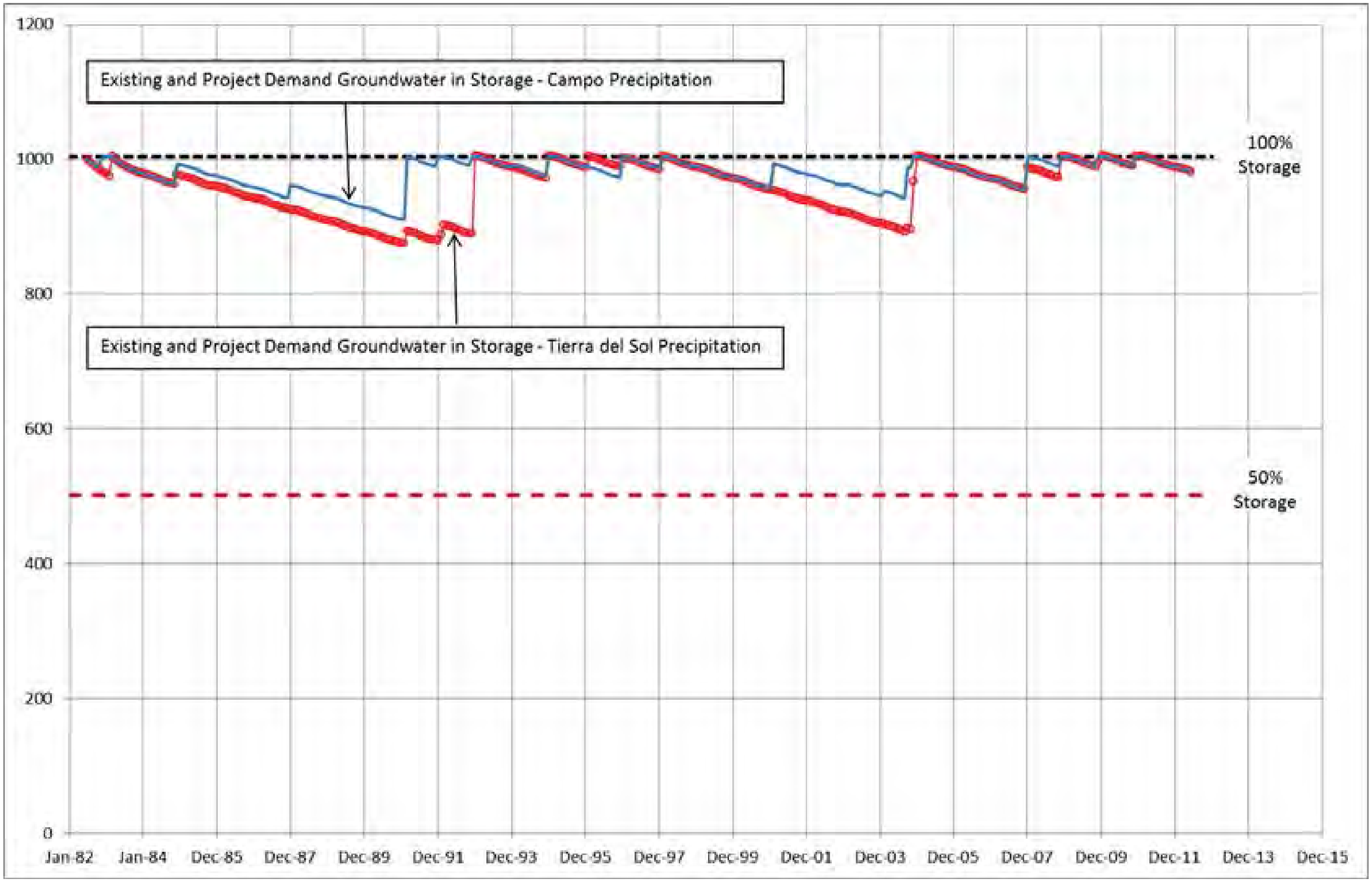
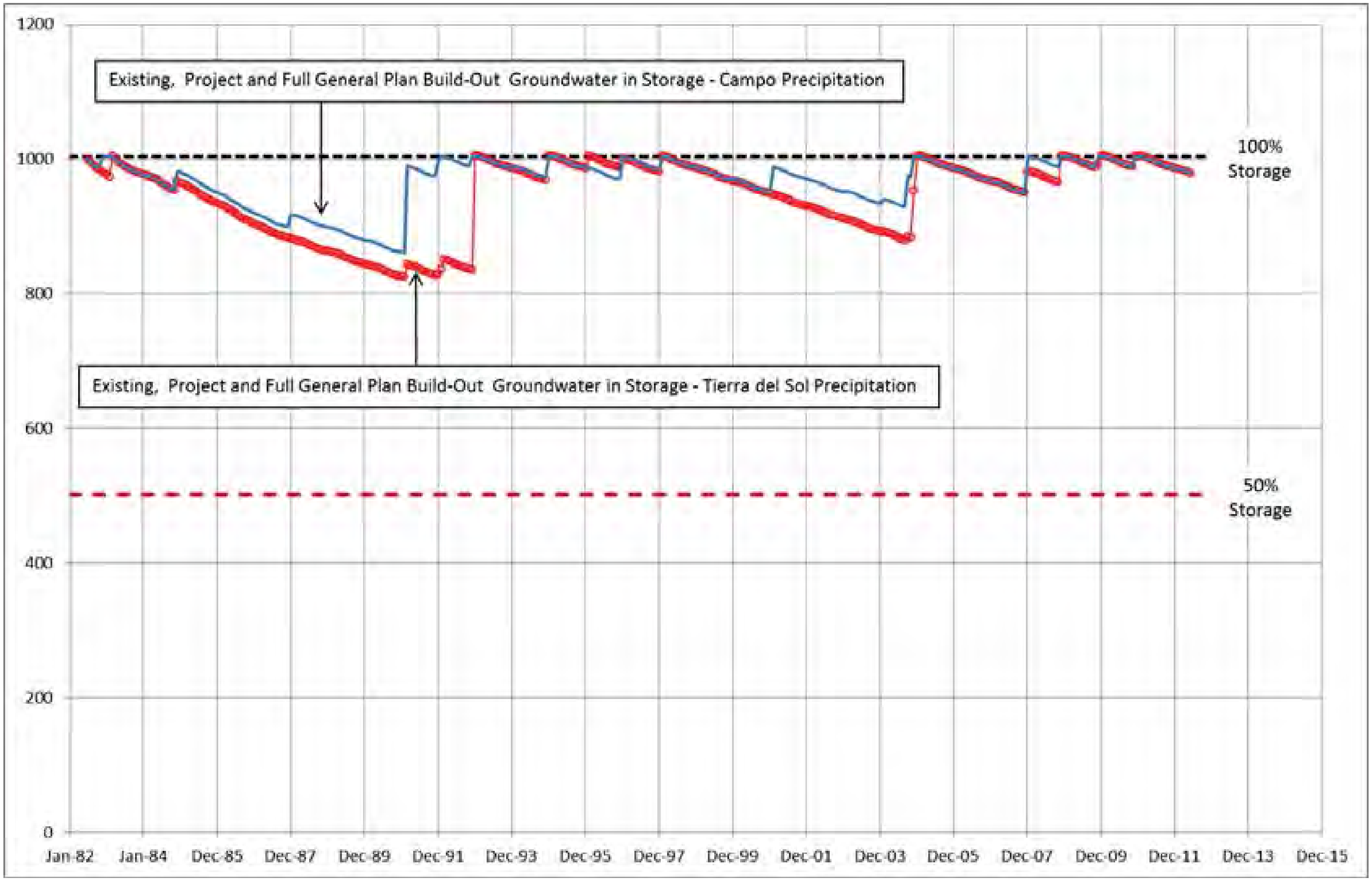


Exhibit 3-F

Scenario 3— Well 8 Existing and Proposed Project Conditions with Rough Acres Ranch Campground, Tule Wind Project, and Full General Plan Build-out



3.1.4 Mitigation Measures and Design Considerations

Because actual conditions during groundwater extraction for the Project may vary from the above analysis, a Groundwater Monitoring and Mitigation Plan (GMMP) will be prepared to ensure that pumping does not unduly impact existing well users. The GMMP will include monitoring the duration and rate of pumping in order to verify the total volume of groundwater removed, and water level monitoring from the pumping well, on-site wells, and off-site wells. A threshold for water level declines in monitoring wells will be developed including mitigation measures such as reduced pumping or a shutdown of pumping until water levels are able to rebound above the established threshold levels.

3.1.5 Conclusions

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

3.2 Well Testing

3.2.1 Guidelines for Determination of Significance

3.2.1.1 Well Interference in Fractured Rock

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

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

According to the County Groundwater Geologist, who was the primary author of the County of San Diego Guidelines, the intent of the above guideline was to cover projects that have continual ongoing water uses that remain static over time. Such projects have, historically comprised the majority of the groundwater dependent projects processed by the County. In recent years, alternative energy projects have proposed producing a relatively large amount of water during the construction portion of the project, which could potentially cause direct well interference impacts from the water demand in these short periods. Therefore, to evaluate potential impacts from short-term pumping of groundwater, the County Groundwater Geologist has requested that in addition to the 5 year projection of drawdown, that a short-term 60-day and 1 year drawdown analysis to evaluate the highest rate of pumping for this Project be provided. These analyses evaluate the construction demand from both the Tule Wind Farm project (Major Use Permit P09-019), the Rough Acres Ranch project (Major Use Permit P12-021) and this Project.

The nearest residential well is located on APN 611-091-07. The exact location of this well is unknown but the property line is located approximately 1,742 feet from Wells 6a and 6b. The Walker residential well is located approximately 2,700 feet northwest of Wells 6a and 6b. The closest property line is 439 feet south of the pumping wells, and is shared with a non-residential, undeveloped parcel. Table 3-11 lists identified wells and County well permits located within half-mile of Wells 6a and 6b.

Table 3-11
Wells 6a/6b Well Users within 0.5 Mile Radius

Well Number	APN	Use	Distance from Wells 6a/6b
Old Ag Well	611-090-02 (RAR Well)	Agriculture	1,571
Well 9	611-090-02 (RAR Well)	Agriculture	2,262
Walker Well	611-090-19	Domestic	2,700
Off-site Confidential Wells[b]			
17532		Agriculture	439[a]
11104		Domestic	1,742[a]
9119		Agriculture	2,326[a]
10107		Agriculture	2,421[a]
11106		Domestic	2,429[a]

a Reported distance is to property line as the exact well location is unknown.
b Assessor parcel numbers are redacted for confidential well logs.

The nearest off-site well to pumping Well 8 is the McCain Conservation Camp Well, located approximately 1,800 feet southeast of Well 8 (GLA 2012a). Table 3-12 lists identified wells located within half-mile of Well 8.

Table 3-12
Well 8 Well Users within 0.5 Mile Radius

Well Number	APN	Use	Distance from Well 8
McCain Conservation Camp Well	611-100-06	Government/Potable	1,800

The total groundwater production demand supplied from Wells 6a and 6b for the Project is estimated at 32.7 acre-feet over the first year for construction and 6.0 afy thereafter for operation over a 30 year project life. The groundwater demand for construction of the Tule Wind Project, assumed to occur immediately prior to construction of the Rugged Project, is estimated to be 56 acre-feet. The existing water demand from Well 6a for Rough Acres Ranch O&M and Tule O&M of 6,600 gpd (7.4 afy) and 2,500 gpd (2.8 afy), respectively and 3,125 gpd (3.5 afy) for residential use is included in the well interference analysis. Thus, the total Wells 6a and 6b proposed water demand is 103.3 acre-feet at the end of construction of the Project and 1,180.7 acre-feet over the life of the Project as indicated in Table 3-13.

Table 3-13
Wells 6a/6b Project Water Demand

Project Activity	Water Demand (acre-feet)	Time	Water Demand Amortized Over Timeframe (gpm)	Total Water Demand Over Timeframe (acre-feet)
Peak Construction Demand	26.5	60 days	100 (60 days)	26.5 (60 days)
Construction	32.7[a] + 56[b] + 14[c] + 0.61[d] = 103.3	1 year	64 (1 year)	103.3 (1 year)
Construction and 4 years O&M	103.3 + (37.15[e] x 4) = 251.9	5 years	31.2 (5 years)	251.9 (5 years)
Construction and 29 years O&M	103.3 + (37.15[e] x 29) = 1,180.7	30 years	24.4 (30 years)	1,180.7 (30 years)

a Construction water demand for Rugged Project.
b Construction water demand for Tule Project.
c Existing demand of 6,600 gpd for Rough Acres Ranch O&M, 2,500 gpd for Tule O&M, and 3,125 gpd for residential use.
d Construction water demand for Phases I and II Rough Acres Ranch Campground Project.
e Annual O&M of 37.15 AF = 13.75 (existing condition see Table 3-3) + 6 O&M Rugged Project +17.4 Future O&M Rough Acres Ranch

Based on the Hantush solution, well interference as a result of peak Project well production from Wells 6a and 6b (occurs during first 60 days of construction) results in a drawdown in the aquifer of 7.1 feet at 439 feet from Wells 6a and 6b. At the end of Project construction (Year 1), drawdown at the nearest residential well property line located approximately 1,742 feet from Wells 6a and 6b is projected at 4.6 feet. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown at nearest residential well property line is projected at 2.6 feet (Table 3-20).

The total groundwater production demand supplied from Well 8 for the Project is estimated at 12 acre-feet over the first year for construction and 8.7 afy thereafter for operation over a 30 year project life. The groundwater demand for construction of the Tule Wind Project, assumed to occur immediately prior to construction of the Rugged Project, is estimated to be 20 acre-feet. The future use of Well 8 for the Rough Acres Ranch Campground Project is estimated at 6.5 afy. Currently, there is no existing use of Well 8. The total Well 8 proposed Project water demand is 472.8 acre-feet over the life of the project as indicated in Table 3-14.

Table 3-14
Well 8 Project Pumping Demand

Project Activity	Water Demand (acre-feet)	Time	Water Demand Amortized Over Timeframe (gpm)	Total Water Demand Over Timeframe (acre-feet)
Peak Construction Demand	6.3 (60 days)	60 days	23.8 (60 days)	6.3 (60 days)
Construction	12[a] + 20[b] = 32	1 year	19.8 (1 year)	32 (1 year)
Construction and 4 years O&M	32 + (8.7[c] + 6.5[d]) x 4 = 92.8	5 years	11.5 (5 years)	92.8 (5 years)
Construction and 29 years O&M	32 + (8.7 + 6.5) x 29 = 472.8	30 years	9.8 (30 years)	472.8 (30 years)

a Construction water demand for Rugged Project.
b Construction water demand for Tule Project.
c O&M for Rugged Project
d O&M for Rough Acres Ranch

Based on the Hantush solution, well interference as a result of peak Project well production from Well 8 (occurs during first 60 days of construction) results in a drawdown in the aquifer of 2.7 feet at 1,800 feet from Well 8. At the end of Project construction (Year 1), drawdown at the nearest production well (McCain Conservation Camp Well) located approximately 1,800 feet from Well 8 is projected at 4.1 feet. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown at the McCain Conservation Well is projected at 3.5 feet (Table 3-24).

Therefore, well interference from groundwater production at Wells 6a, 6b and Well 8 is not predicted to exceed the County threshold of significance: a decrease in water level of 20 feet or more in the off-site wells after a 5-year projection of drawdown. This is considered a less-than-significant impact based on County of San Diego well interference threshold.

3.2.1.2 Groundwater Dependent Habitat

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

> The project would draw down the groundwater table to the detriment of groundwater-dependent habitat, typically a drop of 3 feet or more from historical low groundwater levels.[4]

4 The historical low groundwater levels in the vicinity of the Project site are unknown. Historical water level hydrographs compliled for the Boulevard Planning Group – Manzinita indicate up to 20 feet of water level decline in one well during the period of measurement from 1993 to 2008 (Fiugre 2-33; County of San Diego 2009).

Potential groundwater-dependent vegetation communities occurring on and near the Project site are depicted in Figure 11. There are 7 identified vegetation communities identified on the Project site that may potentially depend on groundwater. These vegetation types include: alkali meadow, big sagebrush scrub, coast live oak woodland, mixed oak woodland, tamarisk scrub, disturbed alkali meadow and disturbed mulefat scrub.

The alkali meadow and disturbed alkali meadow vegetation is typically dependent on surface water with a shallow root system. Species within the alkali meadow have concentrated root masses within 16 inches of ground surface, but some of the phreatophytes within the project boundary, e.g. *Distichlis spicata*, have been documented as having roots extending deeper than 28 inches (Hauser 2006) and establishing in areas where the water table was 12 feet bgs (Robinson 1958). *Juncus mexicanus* dominates the alkali meadows within the project vicinity and is a rhizomatous species with a minimum root depth of 8 inches (NRCS Plant Database 2012). A study of the related *Juncus balticus* has shown a range in rooting depths from near surface (rhizomes) to 20 inches deep (larger roots) in unique cases (Hauser, 2005).

Artemisia tridentata **(big sagebrush scrub)** is not considered a phreatophyte, but the deep-rooted systems of the *Artemisia tridentata* can access groundwater in semiarid regions with limited moisture in the shallow soil horizons (Tiley 2012).

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

Tamarix ramosissima **(tamarisk scrub)** is a deep-rooted phreatophyte that has been documented as accessing water at depths from 33 feet to nearly 100 feet below ground surface (Hatler and Hart 2009; Horton 1977; Robinson 1958). Tamarisk roots (species unknown) penetrating to a depth of 30 meters (nearly 100 feet) were observed in excavations for the Suez Canal (Robinson 1958).

Baccharis salicifolia **(mulefat)** is phreatophyte shrub that requires groundwater levels within 12 inches from the ground surface to establish (NRCS Plant Database 2012), and has been documented for having roots extend to 12 feet below ground surface (Robinson 1958).

Based on the vegetation mapped near Wells 6a and 6b, only the coast live oak woodland and tamarisk scrub communities can likely access water from the alluvial aquifer. The other vegetation communities have shallow root systems and are dependent on surface water or perched groundwater above the water table of the alluvial aquifer. The nearest coast live oak woodland and tamarisk scrub are located 447 feet and 700 feet, respectively from Wells 6a and 6b. Based on the Cooper-Jacob approximation of the Theis non-equilibrium flow equation analysis, at the end of Project construction, drawdown in the aquifer is 5.6 feet and 5.4 feet at distances 447 feet and 700 feet from Wells 6a and 6b. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown in the aquifer is 3.2 feet and 2.9 feet at distances of 447 feet and 700 feet from Wells 6a and 6b (Table 3-20). Summing the current average depth to water of 14 feet bgs and the additional 5.6 feet of Project drawdown, the projected water table may be as low as 19.6 feet bgs at the nearest coast live oak woodland. For the tamarisk scrub, the predicted drawdown could be as much as 5.4 feet based on the projected drawdown analysis performed in Section 3.2.2.2. Summing the current average depth to water of 14 feet bgs and the additional 5.4 feet of Project drawdown, the projected water table may be as low as 19.4 feet bgs for the tamarisk scrub. This analysis assumes that the drawdown in the fractured rock aquifer results in equal drawdown in the alluvial aquifer. As discussed in Section 3.2.2.2, drawdown in the alluvial aquifer is estimated to be less than drawdown in the fractured rock aquifer.

The historical low groundwater level in the vicinity of the oak woodland and tamarisk scrub 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. Therefore, routine biological monitoring and aquifer water level monitoring for the duration of the 1 year Project construction period will serve as a means to continually assess health of the groundwater dependent habitat as described in detail in the GMMP.

Big sagebrush scrub is the only potentially groundwater dependent habitat mapped near Well 8. Big sagebrush scrub requires groundwater to be present in shallow soil horizons and therefore is dependent on surface water or perched groundwater. The alluvial water table near Well 8 is currently at 16 feet bgs. Thus, the roots of the big sagebrush scrub do not intercept the alluvial aquifer and no impact to the big sagebrush scrub is expected.

3.2.2 Well Testing / Methodology

The following sections (3.2.2.1 and 3.2.2.2) describe the procedures followed during the aquifer testing at Wells 6a and 6b, and Well 8. Wells 6a and 6b are located in the western portion of the Project site (Figure 10). Well 8 is located on a separate parcel which constitutes the eastern portion of the Project site (Figure 10).

3.2.2.1 Wells 6a and 6b 72 Hour Constant Rate Test Description

Well 6b was installed on August 28, 2012, approximately 75 feet east of Wells 6 and 6a, and was drilled to a total depth of 680 feet. The driller's log indicates that the borehole collapsed to a total depth of 480 feet. A submersible pump and motor were installed to a depth of approximately 440 feet below top of casing (btoc). A 0.75-inch PVC sounding tube was installed to a depth of 438 feet btoc. Well 6a was drilled to a depth of 420 feet bgs and completed to a depth of 385 feet bgs in February, 2010. Well 6a is fitted with a submersible pump which is used to provide the ranch with water for irrigation and potable supply.

Dudek performed a 12 hour step test at Well 6b on December 20, 2012 from 9:15 to 21:25 (Figure 22). The purpose of this test was to establish an optimal pumping rate for the 72 hour aquifer test. A 72 hour aquifer test was performed by pumping Wells 6a and 6b simultaneously, beginning January 8, 2013, at 12:00 and ending on January 11, 2013, at 12:09. The 72 hour aquifer test was performed to determine the feasibility of groundwater use for on-site construction and operational water supply and to characterize the hydraulic properties of the well. Tables 3-15 through 3-18 summarize the simplified lithology and completion materials of Wells 6a and 6b.

Water quality samples were collected on January 10, 2013, at 9:00. The results of the water quality analysis are described in detail in Section 4.2.2.

Table 3-15
Well 6a Simplified Lithologic Log

Depth (Feet, bgs)	Description
0–70	Soft, Sandy, Rocks (Interpreted as **Alluvium**)
70-87	Harder, Cracks (Interpreted as **DG**)
87-420	Black, White and Orange Rock (Interpreted as **Tonalite**)

Table 3-16
Well 6b Simplified Lithologic Log

Depth (Feet, bgs)	Description
0-65	Sand, Rocks, Soft (Interpreted as **Alluvium**)
65-198	Rock, Loose Rock (Interpreted as **DG**)
198-680	Rock, Orange, White and Soft, Loose Rocks, Caved In (Interpreted as **Tonalite**)

Table 3-17
Well 6a Completion Details

Depth (Feet, bgs)	Borehole Diameter (Inches)	Casing and Materials
0–75	12	6.625-inch, 0.188-inch wall Steel Casing
75-385	6.5	4-inch PVC Liner (CL200)
0-50	12	Annular Cement Seal
50-75	12	Annular Bentonite Seal
75-385	6.5	Annular Filter Pack (Pea Gravel)

Table 3-18
Well 6b Completion Details

Depth (Feet, bgs)	Borehole Diameter (Inches)	Casing and Materials
0–16	12	12-inch, 0.188-inch wall Steel Casing
16-67	10	10-inch, 0.188-inch wall Steel Casing
67-480	6	6-inch PVC Liner (CL200)
0–16	12	Annular Bentonite Seal
16-67	10	Annular Cement Seal
67-480	6	Annular Filter Pack (Pea Gravel)

An In-Situ, Inc. (In-Situ) Level Troll 700 pressure transducer was installed at a depth of 433 feet btoc in Well 6b on November 28, 2012. A pressure transducer was not installed in Well 6a due to limited surface completion access. Manual water level measurements were recorded from Well 6a prior to, during, and after the 72 hour aquifer test. A Solinst Barologger was stored in the Well 6 pump house and used to measure barometric pressure prior to, during, and after the 12 hour and 72 hour tests. The pressure transducer data collected in the pumping well and observation wells were corrected using this barometric data. Manual water level measurements were recorded prior to the test and at the start of the test (Appendix D). Flow and total gallons pumped were measured at Wells 6a and 6b using in-line flow meters equipped with a flow totalizer.

Pressure transducers were installed in on-site Wells 6, 8, 8a, 9, and the Old Ag Well, and off-site Wells 1, 2, and 3 in order to quantify the drawdown, if any induced by the aquifer test. Automatic water level readings were recorded prior to, during, and after the pump test by the pressure transducers installed in the wells. Multiple manual water level measurements were recorded in the observation wells when possible, including at the time of transducer installation and at time of data downloads from the pressure transducer. Drawdown during the combined Wells 6a and 6b 72 hour constant rate test was only observed in Well 6.

The static water level in Well 6a and Well 6b prior to the start of the 72 hour test was measured at 16.18 feet btoc and 14.70 feet btoc, respectively. The 72 hour constant rate aquifer test commenced on January 8, 2013, at 12:00. Well 6a was pumped at an average flow rate of 49 gpm over the duration of the test. The total volume of water pumped over the 72 hour period of the test from Well 6a was 210,441 gallons. Well 6b was pumped at an average flow rate of 39 gpm over the duration of the test. The total volume of water pumped over the 72 hour period of the test from Well 6b was 167,066 gallons. Thus a combined total of 377,507 gallons was pumped from Wells 6a and 6b during the 72 hour constant rate aquifer test. The pumped water was discharged to a stock pond located approximately 1,350 feet northeast of Wells 6a and 6b.

3.2.2.2 Wells 6a and 6b 72 Hour Constant Rate Test Analysis

After approximately 72 hours of pumping, the maximum drawdown observed was 35.98 feet in Well 6a, 139.6 feet in Well 6b (pumping wells) and 8.29 feet in the nearest observation well, Well 6. The results of the Wells 6a and 6b 72 hour aquifer test are presented graphically in Figures 22 through 27. 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^3/day) [multiply gpm by 192.51]
> π = pi (3.14)
> Δs = difference in drawdown over one log cycle (feet)

The transmissivity (T) calculated using the data collected from Well 6b is 105.8 feet^2/day or 791.7 gpd/ft (Figure 25). The transmissivity calculated using the data collected from Well 6 is 1,005 feet^2/day or 7,517 gpd/ft (Figure 26).

Additionally, the aquifer properties were estimated using the computer program Aqtesolv Pro, version 4.50 (Aqtesolv). The aquifer properties were estimated using the time-drawdown data from the observation well, Well 6. The center of pumping in relation to Well 6 was calculated and the pumping rates from Wells 6a and 6b were summed, providing a combined rate of 88 gpm. The transmissivity values obtained through the Aqtesolv modeling software ranged from 756 feet^2/day to 1,255 feet^2/day (5653 to 9,388 in gpd/ft). The transmissivity estimated from Well 6 that best fit the data is 931.1 feet^2/day or 6,965 gpd/ft using the Theis Recovery solution with a sum of squares of 0.056. Table 3-19 shows the range of aquifer parameters and residual statistics obtained from the Aqtesolv modeling.

Table 3-19
Well 6 Range of Transmissivity Values

Solution Method	Parameter Estimates			Residual Statistics
	Transmissivity ($feet^2$/day)	*Conductivity (feet/day)*	*Storativity*	*Sum of Squares ($feet^2$)*
Theis	1,044.3	NA	0.00127	2,620
Theis Recovery	931.1	1.86	NA	0.056
Cooper–Jacob	1,255.1	2.51	0.00055	28.78
Hantush Leaky Aquifer	756	1.512	0.001192	14.12
Average Value	**996.6**	**1.96**	**0.00100**	

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. The coefficient of storage is also estimated using the Copper-Jacob approximation to the Theis equation (Cooper-Jacob 1946) as follows:

$$S = 2.25Tt_o/r^2$$

Where:

S = Coefficient of Storage (dimensionless)
T = transmissivity ($feet^2$/day) = 1,005 $feet^2$/day
t_o = intercept with x-axis, time (days) = 0.0010 days
r = distance to observation well (feet) = 43 feet

The coefficient of storage (S) calculated from data obtained in the observation well (Well 6) is 0.0012 (Figure 26). The Cooper-Jacob method was verified by validating that dimensionless time (u) is sufficiently small (u <0.05) using the equation as follows:

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

Where:

u = time (dimensionless)
r = distance to center of pumping (feet) = 43 feet
S = Coefficient of Storage (dimensionless)
T = transmissivity ($feet^2$/day) = 954 $feet^2$/day
t = time since pumping started

Values for the constants T and S were calculated from the observation well (Well 6) data collected during the Wells 6a and 6b 72 hour constant rate test. During a constant rate aquifer test, drawdown data plot on a straight line except at large values of u, or small values of 1/u. At values of u less than about 0.05, the Cooper-Jacob approximation is valid (Driscoll, 2003). For the 72 hour constant rate test, a sufficiently small value of u was assumed and used to solve for time since pumping started (t) (Figures 26). The calculated value of t was 16 minutes, which is less than or equal to the data used for the Cooper-Jacob approximation, validating the analysis.

Projected drawdown to occur in pumping well, Well 6b after 1 and 5 years of pumping at a combined rate of rate of 88 gpm in Wells 6a and 6b is predicted by forward forecasting using the Cooper-Jacob straight-line method to 1 year (525,949 minutes) and 5 years (2,628,000 minutes). The predicted drawdown at 1 and 5 years is 170 feet and 180 feet, respectively (Figure 25).

The Hantush leaky aquifer curve fitting method takes into account leakage from an adjacent aquifer through and aquitard with storage (Kruseman 1991). This best describes the situation at the site where alluvium and decomposed granite residuum overly the fractured rock aquifer tapped by Wells 6a and 6b. Both wells have conductor casings and blank casing with cement annular seals that isolate the wells from the alluvium. The potential drawdown near the center of pumping between Wells 6a and 6b and at distances listed in Table 3-20 were estimated using the Hantush solution as follows:

$$s = \frac{Q}{4\pi T} W(u,\beta)$$

Where: and

$$u = \frac{r^2 S}{4Tt}$$

$$\beta = r\,(K'S'/TB'S)^{0.5}$$

The Hantush leaky aquifer curve fitting method fit the observed drawdown better than the Theis curve. The sum of squared residuals was 14 feet squared versus 2,620 feet squared for Theis. The best fit Hantush curve was not dramatically different from the Theis curve indicating a small amount of leakage to the pumped aquifer (the fractured granite) from the overlying alluvium and decomposed granite residuum. The transmissivity calculated from Well 6 of 756 $feet^2$/day using the Hantush leaky aquifer curve fitting method was used for the drawdown calculations.

Table 3-20
Wells 6a/6b Drawdown Calculations (Hantush)

Distance from Pumping Center (feet)	Projected Drawdown after 60 days of Pumping[a] (feet)	Projected Drawdown after 1 year of Pumping[b] (feet)	Projected Drawdown after Five Years of Pumping[c] (feet)
50	12.0	9.0	5.1
100	10.5	8.2	4.5
250	8.5	6.9	3.8
439	7.5	6.0	3.3
447	7.5	5.6	3.3
500	7.3	5.6	3.3
700	6.3	5.4	3.2
750	6.3	5.3	3.1
1,000	5.7	5.0	2.9
1,742	4.3	4.6	2.6
2,640	3.7	3.4	2.3
5,280	1.8	2.6	1.8

[a] Assumes constant pumping (24 hours per day for 60 days) at a production rate of 100 gpm.
[b] Assumes constant pumping (24 hours per day 365 days per year) at production rate of 64 gpm.
[c] Assumes constant pumping (24 hours per day 365 days per year) at production rate of 31.2 gpm.

Pumping rates for the 60 day, 1 and 5 year drawdown calculations are 100, 64 and 31.2 gpm respectively. The 1 and 5 year rates are based on the existing and construction demands from the wells for the first year, followed by the operational demands for years 2-5. The demands are amortized over the period analyzed. Drawdown in the fractured rock aquifer 50 feet from the center of pumping of Wells 6a and 6b at a constant rate is estimated to be 12.0 feet after 60 days, 9.0 feet after 1 year, and 5.1 feet after 5 years. Estimated drawdown at 2,640 feet from the center of pumping is 3.7 feet after 60 days, 3.4 feet after 1 year and 2.3 feet after 5 years. Although this methodology does not allow one to predict drawdown in the overlying alluvial aquifer due to leakage through the residuum, it will be much less than the drawdown in the pumped fractured rock aquifer. Thus, the saturated alluvium (approximately 50 feet) at Wells 6a and 6b is unlikely to be dewatered as a result of Project groundwater extraction.

The nearest residential well is located on APN 611-091-07. The exact location of this well is unknown but the property line is located approximately 1,742 feet from Wells 6a and 6b. The Walker residential well is located approximately 2,700 feet northwest of Wells 6a and 6b. The closest property line is 439 feet south of the pumping wells, and is shared with a non-residential, undeveloped parcel. Drawdown at the nearest property line (439 feet south) as a result of Project pumping from Wells 6a and 6b after 5 years is predicted to be 3.2 feet. As the nearest property line borders an undeveloped parcel, well interference with the parcel would only be applicable at full general plan buildout (i.e. the parcel is developed). Drawdown at the nearest property line with a residential well (1,742 feet northwest) as a result of Project pumping from

Wells 6a and 6b after 5 years is predicted to be 2.3 feet as indicated in Table 3-20. This would be considered to be a less than significant impact based on County of San Diego the well interference threshold listed Section 1.3.

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 27). 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 0.5 feet compared to the static water level prior to well testing.

3.2.2.3 Well 8 72 Hour Constant Rate Test Description

Well 8 was originally drilled to a depth of 970 feet bgs, however the borehole collapsed to a depth of 381 feet. Recently, Well 8 was re-drilled to a depth of approximately 500 feet bgs. A 4-inch PVC liner was installed to an unknown depth inside the existing 6 inch steel conductor casing, which was installed to a depth of 226 feet bgs when the well was initially drilled. On December 27, 2012, Dudek measured a total depth of 376 feet bgs in Well 8. A submersible pump and a 7.5 horsepower Franklin Electric motor was installed to a depth of 252 feet bgs. Well 8 was pumped continuously for 4 hours by Bob Walker of Rough Acres Ranch at decreasing pumping rates pumping rates (63 gpm during the 1st hour, 47 gpm during the 2nd hour, 40 gpm during the 3rd hour and 37 gpm during the 4th hour) in September 2012. No water level measurements were recorded during this test.

On January 3, 2013 Dudek performed a 4 hour constant rate test. The purpose of this test was to determine if Well 8 could sustain a pumping rate of 30 gpm for the 72 hour aquifer test. The pumping rate was 30 gpm for approximately 2 hours, after which the flow rate dropped to 18 gpm and the water level began to slowly recover. Observed drawdown in Well 8 over the first 2 hours was 114 feet. After the 4 hour test, it was discovered that the Sensus flow meter which was installed in-line with the discharge manifold had become filled with coarse, sand-sized material produced from the well. In order to maintain a constant flow rate during the 72 hour test, a Lakos sand-separator was installed in-line with the discharge manifold before the Sensus flow meter.

The 72 hour aquifer test was performed at Well 8 beginning January 16, 2013, at 11:52 and ending on January 19, 2013, at 11:58. Water quality samples were collected on January 18, 2013, at 11:45. The results of the water quality analysis are described in detail in Section 4.2.2. The 72 hour aquifer test was performed to determine the feasibility of groundwater use for on-site construction and operational water supply and to characterize the hydraulic properties of the well. Tables 3-21 and 3-22 summarize the simplified lithology and completion materials of Well 8.

Table 3-21
Well 8 Simplified Lithologic Log

Depth (Feet, bgs)	Description
0–12	Slope Wash, Sandy, Brown Color (Interpreted as **Alluvium**)
12-310	Weathered and Broken Granitic Rock (Interpreted as **DG**)
310-970	Granitic Rock, Fractured Granitic Rock, Large Quartz Crystals (Interpreted as **Tonalite**)

Table 3-22
Well 8 Completion Details

Depth (Feet, bgs)	Borehole Diameter (Inches)	Casing and Materials
0–226	10	6-inch I.D. by 0.188-inch wall Steel Casing
Unknown	10	4-inch PVC Liner
0–50	10	Annular Cement Seal
50-226	10	Annular Filter Pack (Not Specified)

Prior to the 4 hour test, a Solinst Gold F-300 Level Logger pressure transducer was installed at a depth of 249 feet btoc on December 27, 2012. A Solinst Barologger was stored in the Well 6 pump house and measured barometric pressure before, during, and after the 4 hour and 72 hour tests. The pressure transducer data collected in the pumping well and observation wells were corrected using this barometric data. Manual water level measurements were recorded prior to the test and at the start of the test. An obstruction was encountered at approximately 88 feet bgs in Well 8 and manual measurements were not recorded below this depth (Appendix D). Flow and total gallons pumped were measured using an in-line Sensus flow meter equipped with a flow totalizer.

Pressure transducers were installed in on-site Wells 6, 8, 8a, 9, and the Old Ag Well, and off-site Wells 1, 2, and 3 in order to quantify the effects, if any, of the drawdown induced by the aquifer test. Automatic water level readings were recorded prior to, during, and after the pump test by the pressure transducers installed in the wells. Manual water level measurements were recorded in nearest observation well (Well 8a, located 286 feet east of Well 8) when possible (including at the time of transducer installation and at time of data downloads from the pressure transducer). The next closest accessible observation well is Well 1, located approximately 0.9 miles north of Well 8. Drawdown was only observed in Well 8a during the testing at Well 8.

The static water level in Well 8 prior to the start of the 72 hour test was measured at 16.3 feet btoc. The 72 hour constant rate aquifer test commenced on January 16, 2013, at 11:52. Well 8 was pumped at an average flow rate of 27 gpm over the duration of the test. The total volume of water pumped over the 72 hour period of the test was 118,058 gallons. The pumped water was discharged via sprinkler heads to an open pasture located approximately 400 feet north of Well 8.

3.2.2.4 Well 8 72 Hour Constant Rate Test Analysis

After approximately 72 hours of pumping, the maximum drawdown observed was 194.32 feet in Well 8 (pumping well) and 6.60 feet in the observation well (Well 8a). The results of the Well 8 aquifer test are presented graphically in Figures 28 through 32. 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%) was estimated 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 ($feet^3$/day) [multiply gpm by 192.51]
π = pi (3.14)
Δs = difference in drawdown over one log cycle (feet)

The T calculated using the data collected from Well 8 is 18.7 $feet^2$/day or 139.7 gpd/ft (Figure 30). The T calculated using the data collected from Well 8a is 153.6 $feet^2$/day or 1,149.2 gpd/ft (Figure 31). Additionally, the aquifer properties were estimated using the computer program Aqtesolv Pro, version 4.50 (Aqtesolv). The data required for this modeling software included the water level in the pumping well and observation well, the rate of pumping, and elapsed time. The aquifer properties were estimated using the time-drawdown data from the observation well (Well 8a). The transmissivity values obtained through the Aqtesolv modeling software ranged from 58.6 $feet^2$/day to 163.3 $feet^2$/day (438.3 to 1,221.5 in gpd/ft). The transmissivity estimated from Well 8a that best fit the data is 163.3 $feet^2$/day or 1,222 gpd/ft using the Theis Recovery solution with a sum of squares of 25.99. Table 3-23 shows the range of aquifer parameters and residual statistics obtained from the Aqtesolv modeling.

Table 3-23
Well 8a Range of Transmissivity Values

Solution Method	Parameter Estimates			Residual Statistics
	Transmissivity ($feet^2$/day)	*Conductivity (feet/day)*	*Storativity*	*Sum of Squares ($feet^2$)*
Theis	105.3	0.2106	0.00193	2,206.7
Theis Recovery	163.3	0.327	NA	25.99
Cooper–Jacob	157.6	0.3152	0.00124	1,641.6
Hantush Leaky Aquifer	58.62	0.1172	0.00130	76.3
Average Value	**121.2**	**0.2425**	**0.00149**	

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. The coefficient of storage is also estimated using the Copper-Jacob approximation to the Theis equation (Cooper-Jacob 1946) as follows:

$$S= 2.25Tt_o/r^2$$

Where:

S = Coefficient of Storage (dimensionless)
T = transmissivity ($feet^2$/day) = 152.9 $feet^2$/day
t_o = intercept with x-axis, time (days) = 0.32 days
r = distance to observation well (feet) = 286 feet

The coefficient of storage (S) calculated from data obtained in the observation well (Well 8a) was 0.0014 (Figure 31). The Cooper-Jacob method was verified by validating that dimensionless time (u) is sufficiently small (u <0.05) using the equation as follows:

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

Where:

u = time (dimensionless)
r = distance to center of pumping (feet) = 43 feet
S = Coefficient of Storage (dimensionless)
T = transmissivity ($feet^2$/day) = 954 $feet^2$/day
t = time since pumping started

Values for the constants T and S were calculated from the observation well (Well 8a) data collected during the Well 8 72 hour constant rate test. During a constant rate aquifer test, drawdown data plot on a straight line except at large values of u, or small values of 1/u. At values of u less than about

0.05, the Cooper-Jacob approximation is valid (Driscoll, 2003). For the 72 hour constant rate test, a sufficiently small value of u was assumed and used to solve for time since pumping started (t) (Figure 26). The calculated value of t is 5,328 minutes, which is greater than the data used for the Cooper-Jacob approximation. Thus the Jacob analysis is not valid. Therefore, the transmissivity of 163.3 feet^2/day (1221.5 gpd/ft) from the Theis recovery solution and storage coefficient of 0.0013 from the Hantush leaky aquifer solution were used to estimate aquifer parameters for Well 8a. These solutions were chosen because they had the best fit, least sum of squares, in Aqtesolv (Table 3-23).

Projected drawdown in the pumping well (Well 8) after 1 and 5 years of pumping at a rate of 27 gpm was predicted by forward forecasting using the Cooper-Jacob straight-line method to 1 year (525,949 minutes) and 5 years (2,628,000 minutes). The predicted drawdown at 1 and 5 years was calculated at 310 feet and 345 feet, respectively (Figure 30). As the Project amortized pumping rate for Well 8 over a 5 year period is 11.5 gpm including 1 year of construction and 4 years of operational water demands, the projected drawdown in Well 8 is 146.9 feet after 5 years. Therefore, Well 8 will be able to sustain production over the 5 year period analyzed. Additionally, deep water producing fractures were encountered during drilling the original Well 8 borehole to a depth of 970 feet bgs in 2005. The highest yielding fracture was located at 961 feet bgs and reported to produce 40 gpm while airlifting (DWR Well Log). Due to formation collapse, Well 8 was originally installed to 226 feet. Well 8 was later redrilled (after GLA Tule Wind Project testing at 18 gpm) and completed to a total depth of 376 feet bgs. The reinstalled well sustained 27 gpm during the Dudek 72 hour well test. Fractured rock wells typically drawdown under sustained pumping at maximum rates to the highest producing fracture. As the highest producing fracture in Well 8 is located in the partially collapsed borehole below the well casing at 961 feet bgs, Well 8 production will likely be sustained until water levels drop to within 10 feet of the pump intake. If the pump intake were to be set 10 feet from the bottom of the well at 366 feet, pumping could likely be sustained until water levels drop below 356 feet in Well 8.

The Hantush leaky aquifer curve fitting method takes into account leakage from an adjacent aquifer through and aquitard with storage (Kruseman 1991). This best describes the situation at the site where alluvium and decomposed granite residuum overly the fractured rock aquifer tapped by Well 8. Well 8 has a conductor casing and blank casing with a cement annular seal that isolates the well from the alluvium. The potential drawdown in the fractured rock aquifer was estimated using the Hantush solution as follows:

$$s = \frac{Q}{4\pi T} W(u,\beta)$$

Where: and

$$u = \frac{r^2 S}{4Tt} \qquad \beta = r\,(K'S'/TB'S)^{0.5}$$

The Hantush solution fit the observed drawdown better than the Theis curve. The sum of squared residuals was 76 feet squared versus 2,207 feet squared for Theis. The best fit Hantush curve was not dramatically different from the Theis curve indicating a small amount of leakage to the pumped aquifer (the fractured granite) from the overlying alluvium and decomposed granite residuum.

Table 3-24
Well 8 Drawdown Calculations (Hantush)

Distance from Pumping Center (feet)	Projected Drawdown after 60 days of Pumping[a] (feet)	Projected Drawdown after 1 year of Pumping[b] (feet)	Projected Drawdown after Five Years of Pumping[c] (feet)
50	11.4	11.2	7.3
100	10.0	9.7	6.6
250	7.6	8.0	5.5
500	6.3	6.7	4.9
750	4.9	6.3	4.3
1,000	4.2	5.4	4.2
1,800	2.7	4.1	3.5
2,640	1.8	3.4	2.9
5,280	0.3	1.9	2.2

a Assumes constant pumping (24 hours per day for 60 days) at a production rate of 23.8 gpm.
b Assumes constant pumping (24 hours per day 365 days per year) at production rate of 19.8 gpm.
c Assumes constant pumping (24 hours per day 365 days per year) at production rate of 11.5 gpm.

Project amortized pumping rate for Well 8 over a 1 year period is 19.8 gpm for construction demands, and over a 5 year period is 11.5 gpm including 1 year of construction and 4 years of operational water demands. Drawdown in the fractured rock aquifer 50 feet from Well 8 is estimated to be 11.4 feet after 60 days, 11.2 feet after 1 year and 7.3 feet after 5 years. Estimated drawdown at 1,800 feet from Well 8 is 2.7 feet after 60 days, 4.1 feet after 1 year and 3.5 feet after 5 years. Although this methodology does not allow one to predict drawdown in the overlying alluvial aquifer due to leakage through the residuum, it will be much less than the drawdown in the pumped fractured rock aquifer.

Drawdown at the nearest off-site well (McCain Conservation Camp Well) as a result of Project pumping from Well 8 after 5 years is predicted to be 3.5 feet as indicated in Table 3-24. This would be considered to be a less than significant impact based on County of San Diego the well interference threshold listed Section 1.3.

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 32). 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 2 feet compared to the static water level prior to well testing.

3.2.3 Significance of Impacts Prior to Mitigation

Based on the above analysis for Wells 6a and 6b (Table 3-20), well interference due to peak Project well production (occurs during first 60 days of construction) is estimated to be 4.3 feet at the nearest property line with a residential well (1,742 feet) from Wells 6a and 6b. After one year of pumping, including peak construction demand, the drawdown is estimated to be 4.6 feet. After 5 years, which includes 1 year of construction and 4 years of operation, drawdown is estimated to be 2.6 feet at the nearest residential property line that has a residential well.

Based on the above analysis for Well 8 (Table 3-24), well interference due to peak Project well production (occurs during first 60 days of construction) results in an estimated drawdown of 2.7 feet at the nearest off-site well (McCain Conservation Camp) located approximately 1800 feet from Well 8. After 1 year of pumping, including peak construction demand, drawdown is estimated to be 4.1 feet. After 5 years, which includes 1 year of construction and 4 years of operation, drawdown is estimated to be 3.5 feet at the nearest off-site well.

Therefore, off-site well interference as a result of Project well production from Wells 6a, 6b and Well 8 is not predicted to exceed the County threshold of significance of a decrease in water level of 20 feet or more in the off-site wells after a 5-year projection of drawdown.

The nearest coast live oak woodland and tamarisk scrub are located 447 feet and 700 feet, respectively from Wells 6a and 6b. Based on the Hantush solution, drawdown from peak Project well production (occurs during first 60 days of construction) results in a drawdown in the aquifer of 7.5 feet and 6.3 feet at distances of 447 feet and 700 feet from pumping Wells 6a and 6b. After 1 year of pumping, drawdown in the aquifer is estimated to be 6.0 feet and 5.4 feet at distances of 447 feet and 700 feet from Wells 6a and 6b. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown in the aquifer is 3.3 feet and 3.2 feet at distances of 447 feet and 700 feet from Wells 6a and 6b (Table 3-20). Summing the current average depth to water of 14 feet bgs and the additional 7.5 feet of estimated Project drawdown, the projected water table may be as low as 21.5 feet bgs at the nearest coast live oak woodland. For the tamarisk scrub, the predicted drawdown could be as much as 20.3 feet. This analysis assumes that the drawdown in the fractured rock aquifer results in equal drawdown in the alluvial aquifer. As discussed in Section 3.2.2.2, drawdown in the alluvial aquifer is estimated to be less than drawdown in the fractured rock aquifer.

Big sagebrush scrub is the only potentially groundwater dependent habitat mapped near Well 8. Big sagebrush scrub requires groundwater to be present in shallow soil horizons and therefore is dependent on surface water or perched groundwater. The alluvial water table near Well 8 is currently at 16 feet bgs. Thus, the roots of the big sagebrush scrub do not intercept the alluvial aquifer and no impact to the big sagebrush scrub is expected.

The historical low groundwater level in the vicinity of the groundwater dependent habitat near Wells 6a and 6b is unknown. As the lack of historical water level data precludes determination of a water level threshold 3 feet below the historical low, significant impacts to groundwater habitat could occur as a result of Project pumping if no mitigation measures are implemented.

3.2.4 Mitigation Measures and Design Considerations

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

Well Interference: A network of on-site and off-site observation wells has been established to monitor water levels. Pressure transducers will remain in select on-site and off-site wells to record water level fluctuations. In addition to the existing on-site and off-site wells, a new fractured rock monitoring well (MW-SPB) will be installed approximately 350 feet south of Wells 6a and 6b to monitor water levels in the fractured rock aquifer. A maximum drawdown of 15 feet below the water level baseline at MW-SPB will be allowed. This protective threshold will prevent drawdown of 10 feet below the water level baseline at the nearest residential parcel property line located 1,742 feet from the pumping wells.

The nearest off-site well to the pumping well, Well 8, is the McCain Conservation Camp Well, located approximately 1,800 feet southeast of Well 8, which will likely be accessible for monitoring during pumping at Well 8. The McCain Conservation Camp Well will serve as the Well 8 monitoring point for compliance with groundwater drawdown guidelines established by the County. It will be fitted with a pressure transducer in the spring of 2014, which will record water level measurements for approximately 1 year prior to the onset of Project-related groundwater extraction. Transducer accuracy will be confirmed through manual water level measurements recorded with a sounder. The measurements collected from the McCain Conservation Camp Well over this year will be used to establish a water level baseline and capture water level patterns generated by pumping of this well. An understanding of these patterns will likely allow for this well's continued use as a monitoring well despite the possibility that it may be pumped over the duration of the Project. During pumping at Well 8, a maximum drawdown of 10 feet below the pumping baseline will be allowed at the McCain Conservation Camp Well. This threshold takes into account the County guidelines for limiting drawdown in both fractured rock and alluvial aquifers.

Groundwater Dependent Habitat: The network of groundwater observation wells monitored for well interference will also be used to monitor potential effects of water table decline on groundwater dependent habitat. An additional monitoring well (MW-O) is proposed to monitor drawdown in the alluvial aquifer in the vicinity of pumping Wells 6a and 6b. The historical low groundwater level in the vicinity of the oak woodland is not known over the period corresponding to the lifespan of mature oaks. This lack of historical water level data precludes determination of a water level threshold 3 feet below the historical low. Therefore, routine biological monitoring of the oak woodland for the duration of the one year Project construction period will serve as a means to continually assess oak health. Biological monitoring procedures are described in the GMMP. If an International Society of Arboriculture (ISA) Certified Arborist or Registered Profession Forester observes that no impact to the oak woodland has occurred over the construction period, biological monitoring of the oak woodland will cease. In addition to biological monitoring a water level threshold of 10 feet of drawdown below baseline at proposed monitoring well (MW-O) will be established to protect the oaks' ability to continually access groundwater from the alluvial aquifer.

If the groundwater level at well MW-O reaches or drops below 10 feet of the baseline water level, pumping at Wells 6a and 6b will cease until the water level in well MW-O has increased above the threshold and remained there for at least 30 continuous days. Evidence of deteriorating oak tree health as observed by an ISA Certified Arborist or Registered Professional Forester may also result in the temporary cessation of pumping at Wells 6a and 6b.

3.2.5 Conclusions

The well test analysis using San Diego County methodology indicated that off-site well interference is not predicted to be an impact for the Project based on the proposed Project pumping rates for Wells 6a, 6b and Well 8, and time horizons of 60 days, 1 and 5 years. The groundwater dependent vegetation communities mapped near pumping Wells 6a and 6b will be monitored in accordance with the GMMP to ensure no deleterious impacts from water table decline. Pressure transducers will remain in several on-site and off-site wells to record water levels during Project construction and operation. Annual review of water level data should be conducted by a certified hydrogeologist to evaluate long-term impacts.

4.0 WATER QUALITY IMPACT ANALYSIS

This section identifies and defines potential effects of the Rugged Solar Farm 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 used on-site exceeds the primary state or federal MCLs for applicable contaminants. Groundwater would be utilized for site grading and dust control during construction, and periodic washing of solar panels during long-term project operation. Potable water will be required to serve the project's O&M annex site, which would house restrooms and other employee support facilities. If the project cannot demonstrate compliance with applicable MCLs, it will be considered to have a significant impact with respect to groundwater quality.

4.2 Methodology

Sampling procedures and analytical methods used were in compliance with County of San Diego requirements (County of San Diego 2007) and described below. CDPH regulations pertaining to drinking water were also reviewed. California Code of Regulations (CCR) Sections 64400.80–64445 require monitoring for potable water wells based on the number of connections and number of persons the system serves. The Project will be a non-public state small water system (CCR Sections 64211–64217) regulated by the local primacy agency, the County. The following details the sampling procedures and water quality results for Wells 6b and 8.

4.2.1 Well 6b

4.2.1.1 Sampling Procedures

To determine whether the production well for the Project would exceed applicable MCLs, water samples were collected from Well 6b on January 10, 2013. Well 6b had been pumping at an average rate of 40 gpm for 45 hours when the water samples were collected. Therefore, approximately 108,000 gallons were purged from Well 6b prior to sampling, greatly exceeding the minimum County requirement of two well borehole volumes. The samples were placed in laboratory-certified bottles, packed in a cooler with ice, and delivered under chain-of-custody to E.S. Babcock and Sons, Inc. (Babcock) of San Diego, California, on January 10, 2013, within specified laboratory holding times. Dudek requested water quality analyses from Babcock including nitrate, bacteria (fecal and total coliform), and radionuclide activity, as required under County of San Diego guidelines. Samples were also analyzed for inorganic minerals, volatile organic compounds (VOCs), and general physical/mineral properties. Babcock subcontracted the analyses of Gross Alpha, Radium-226, Radium-228, and Uranium to FGL Environmental.

The laboratory report is included as an appendix to this report (Appendix E).

4.2.1.2 Sample Results

Tables 4-1 through 4-6 list the results of the water quality analyses, analytical method, and comparison to California drinking water primary MCLs and secondary MCLs for each constituent.

Table 4-1
Microbiological Water Quality Results – Well 6b

Constituent	Analytical Method	Units	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCL
Total Coliform	SM9223	MPN	Absent	More than one sample per month is total coliform positive
E. coli	SM9223	MPN	Absent	A positive result for fecal coliform or E. coli samples is an acute MCL violation

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

Table 4-2
General Mineral Water Quality Results – Well 6b

Constituent	Analytical Method	Unit	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCL
Cations				
Total Hardness	EPA 200.7	mg $CaCO_3$/L[a]	170	—
Calcium	EPA 200.7	mg/L[b]	56	—
Magnesium	EPA 200.7	mg/L	6.8	—
Sodium	EPA 200.7	mg/L	49	—
Potassium	EPA 200.7	mg/L	1.6	—
Total Cations	*Calculated*	*me/L*[c]	*5.5*	—
Anions				
Total Alkalinity	SM2320B	mg $CaCO_3$/L	180	—
Hydroxide	SM2320B	mg $CaCO_3$/L	<3	—
Carbonate	SM2320B	mg $CaCO_3$/L	<3	—
Bicarbonate	SM2320B	mg $CaCO_3$/L	220	—
Chloride	SM4500 CL C	mg/L	52	250/500/600[d]

Table 4-2
General Mineral Water Quality Results – Well 6b

Constituent	Analytical Method	Unit	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCL
Sulfate	SM4500 S04 E	mg/L	12	250/500/600[d]
Fluoride	SM4500 F C	mg/L	0.5	2[e]
Nitrate (as NO_3)	SM4500 N03 E	mg/L	4.4	45 (10 as N)
Total Anions	*Calculated*	*me/L*	*5.41*	
Aggregate Properties				
pH	SM2540 C	pH Units	7.6	6.5 – 8.5[e]
Specific Conductance	SM2510 B	umhos/cm	530	900/1,600/2,200[d] (µS/cm)[f]
Solids				
Total Dissolved Solids	SM2540 C	mg/L	330	500/1,000/1,500[d]
General Physical				
Color	SM2120 B	Color Units	<3	15
Odor	SM2150 B	T.O.N.[g]	<1	3
Turbidity	SM2130 B	NTU[h]	<0.2	5

a. milligrams calcium carbonate per liter = mg $CaCO_3$/L
b. milligrams per liter = mg/L.
c. milliequivalents per liter = me/L
d. Recommended/Upper/Short-Term Secondary MCLs.
e. Secondary MCL.
f. Umhos/cm = µS/cm.
g. Threshold Odor Number = T.O.N.
h. Nephelometric Turbidity Units = NTU

Table 4-3
Inorganic Minerals Water Quality Results – Well 6b

Constituent	Analytical Method	Unit	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCL
Aluminum	EPA 3010A	ug/L[d]	<50	1,000
Antimony	EPA 200.8	ug/L	<6	6
Arsenic	EPA 200.8	ug/L	<2	10
Barium	EPA 200.8	ug/L	<100	1,000
Beryllium	EPA 200.8	ug/L	<1	4
Cadmium	EPA 200.8	ug/L	<1	5
Chromium (Total)	EPA 200.8	ug/L	<1	50
Copper	EPA 200.8	ug/L	<50	1,300[a]
Fluoride	SM4500 F C	mg/L	0.5	2.0[b]
Iron	EPA 3010A	ug/L	<100	300[b]
Lead	EPA 200.8	ug/L	<5	15[a]

Table 4-3
Inorganic Minerals Water Quality Results – Well 6b

Constituent	Analytical Method	Unit	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCL
Manganese	EPA 3010A	ug/L	<20	50[b]
Mercury	EPA 245.1	ug/L	<1	0.002
Nickel	EPA 200.8	ug/L	<10	0.1
Nitrate as $N0_3$ (as N)	SM4500 NO3 E	mg/L[e]	4.4 (0.99)	45 (10 as N)
Nitrite (as nitrogen)	SM4500 NO2 B	mg/L	<100	1 (as N)
Nitrate + Nitrite (sum as nitrogen)	Calculated	mg/L	0.99	10 (as N)
Silver	EPA 200.8	ug/L	<10	—
Selenium	EPA 200.8	ug/L	<5	50
Thallium	EPA 200.8	ug/L	<1	2
Zinc	EPA 200.8	ug/L	95	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 MCL.
c. Atomic weight of nitrogen is 14.0067 and the molar mass of nitrate anion (NO_3^-) is 62.0049 g/mole. To convert nitrate to nitrate-nitrogen: x mg/L nitrate (NO_3) X 0.2259 = y mg/L nitrate nitrogen (NO_3 – N). And to convert nitrate nitrogen: x mg/L(NO_3 – N) X 4.4269 = y mg/L nitrate (NO_3).
d. Microgram per liter = μg/L
e. Milligram per liter = mg/L

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

Constituent	Analytical Method	Units	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCLs
1,1,1,2-Tetrachloroethane	EPA 524.2	ug/L[b]	<0.50	—
1,1,1-Trichloroethane	EPA 524.2	ug/L	<0.50	200
1,1,2,2-Tetrachloroethane	EPA 524.2	ug/L	<0.50	—
1,1,2-Trichloroethane	EPA 524.2	ug/L	<0.50	5
1,1-Dichloroethane	EPA 524.2	ug/L	<0.50	5
1,1-Dichloroethene	EPA 524.2	ug/L	<0.50	6
1,1-Dichloropropene	EPA 524.2	ug/L	<0.50	—
1,2,3-Trichlorobenzene	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 (total)	EPA 524.2	ug/L	<0.50	0.5

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

Constituent	Analytical Method	Units	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCLs
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	—
2-Butanone(MEK-EPA 8260)	EPA 524.2	ug/L	<5.0	—
2-Chlorotoluene	EPA 524.2	ug/L	<0.50	—
4-Chlorotoluene	EPA 524.2	ug/L	<0.50	—
4-Methyl-2-Pentanone(MIBK)	EPA 524.2	ug/L	<5.0	—
Benzene	EPA 524.2	ug/L	<0.50	1
Bis(2-chloroethyl)ether	EPA 524.2	ug/L	<5.0	—
Bromobenzene	EPA 524.2	ug/L	<0.50	—
Bromodichloromethane	EPA 524.2	ug/L	<0.50	—
Bromodichloromethane	EPA 524.2	ug/L	<0.50	—
Bromoform	EPA 524.2	ug/L	<0.50	—
Bromomethane	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	0.54	80[a]
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	—
Dibromochloromethane	EPA 524.2	ug/L	<0.50	—
Dibromomethane	EPA 524.2	ug/L	<0.50	—
Dichlorodifluoromethane	EPA 524.2	ug/L	<0.50	—
Ethylbenzene	EPA 524.2	ug/L	<0.50	300
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
n-Butylbenzene	EPA 524.2	ug/L	<0.50	—
n-Propylbenzene	EPA 524.2	ug/L	<0.50	—
Naphthalene	EPA 524.2	ug/L	<0.50	—
p-Isopropyltoluene	EPA 524.2	ug/L	<0.50	—
sec-Butylbenzene	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

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

Constituent	Analytical Method	Units	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCLs
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
Vinyl Chloride	EPA 524.2	ug/L	<0.50	0.5
Xylenes (m+p)	EPA 524.2	ug/L	<0.50	—
Xylenes (ortho)	EPA 524.2	ug/L	<0.50	—
Xylenes (Total)	EPA 524.2	ug/L	<0.50	1,750

a. MCL reported is for Total trihalomethanes, which is a sum of Bromodichloromethane, Bromoform, Chloroform and Dibromochloromethane.
b. Microgram per liter = μg/L

Table 4-5
Radiochemistry Water Quality Results – Well 6b

Constituent	Analytical Method	Units	Well 6b Groundwater (Sample from January 10, 2013)	California Drinking Water MCLs
Gross Alpha	EPA 900.0	pCi/L	12.4	15
Uranium	EPA 903.0	pCi/L	9.23	20
Total Alpha Radium (226)	EPA 908.0	pCi/L	0.101	3
Ra 228	Ra - 05	pCi/L	0.000	2

pCi/L = picocuries per liter

Table 4-6
Field Water Quality Parameters – Well 6b

Sample Date/Time	Temperature (°F)	pH	Conductivity (μS/cm)[a]	TDS (mg/L)[b]	Salinity (‰)
1/9/2013 12:25	-	7.32	544	263	0.2
1/10/2013 8:13	63.6	7.06	564	274	0.3
1/10/2013 8:20	64.0	7.33	563	268	0.3
1/10/2013 8:25	64.0	7.54	554	269	0.3
1/10/2013 8:30	64.4	7.58	554	268	0.3
1/10/2013 8:35	64.4	7.60	555	268	0.3

a. Microsiemens per centimeter = μS/cm.
b. Milligrams per liter = mg/L

Water quality results show that all constituents sampled are below U.S. Environmental Protection Agency (EPA) and State of California MCLs. Inorganic constituents detected in water quality samples included fluoride, nitrate reported as $N0_3$ (and as N), nitrate + nitrite (sum as nitrogen), and zinc. All detections were below the primary or secondary applicable MCLs, and most were several orders of magnitude below health-based thresholds. The only VOC detected was chloroform (0.54 ug/L). However, because the detection is several orders of magnitude below the respective MCL (80 ug/L), it is not considered to present a concern with respect to groundwater quality. Periodic water quality sampling shall be conducted for Well 6b to ensure that chloroform concentrations are declining or have stabilized. Elevated concentrations of gross alpha and uranium were also detected. These radionuclides are naturally occurring in bedrock aquifers in San Diego County. Radionuclides should be periodically monitored to ensure detections below MCLs.

4.2.2 Well 8

4.2.2.1 Sampling Procedures

To determine whether the production well for the project would exceed applicable MCLs, water samples from Well 8 were collected on January 18, 2013. Well 8 had been pumping at an average rate of 27 gpm for 48 hours when the water samples were collected. Therefore, approximately 77,760 gallons were purged from Well 8 prior to sampling, greatly exceeding the minimum County requirement of two well borehole volumes. The samples were placed in laboratory-certified bottles, packed in a cooler with ice, and delivered under chain-of-custody to Babcock on January 18, 2013, within specified laboratory holding times. Dudek requested water quality analyses from Babcock 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, VOCs, and general physical/mineral properties. Babcock subcontracted the analyses of Gross Alpha, Radium-226, Radium-228, and Uranium to FGL Environmental.

The laboratory reports are included as an appendix to this report (Appendix E).

4.2.2.2 Sampling Analysis

Tables 4-7 through 4-12 list the results of the water quality analyses, analytical method, and comparison to California Drinking Water primary MCLs and secondary MCLs for each constituent.

Table 4-7
Microbiological Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
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 4-8
General Mineral Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
Cations				
Total Hardness	EPA 200.7	mg $CaCO_3$/L[a]	250	—
Calcium	EPA 200.7	mg/L[b]	76	—
Magnesium	EPA 200.7	mg/L	14	—
Sodium	EPA 200.7	mg/L	62	—
Potassium	EPA 200.7	mg/L	3.6	—
Total Cations	*Calculated*	*me/L*[c]	*7.7*	—
Anions				
Total Alkalinity	SM2320B	mg $CaCO_3$/L	230	—
Hydroxide	SM2320B	mg $CaCO_3$/L	<3	—
Carbonate	SM2320B	mg $CaCO_3$/L	<3	—
Bicarbonate	SM2320B	mg $CaCO_3$/L	280	—
Chloride	SM4500 CL C	mg/L	89	250/500/600[d]
Sulfate	SM4500 S04 E	mg/L	17	250/500/600[d]
Fluoride	SM4500 F C	mg/L	0.2	—
Nitrate (as NO_3)	SM4500 N03 E	mg/L	<1.0	45 (10 as N)
Total Anions	*Calculated*	*me/L*	*7.47*	
Aggregate Properties				
pH	SM2540 C	pH Units	7.4	6.5 – 8.5[b]
Specific Conductance	SM2510 B	umhos/cm	750	900/1,600/2,200[e] (µS/cm)[f]
Solids				
Total Dissolved Solids	SM2540 C	mg/L	460	500[e]

Table 4-8
General Mineral Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
General Physical				
Color	SM2120 B	Color Units	<3	15
Odor	SM2150 B	T.O.N.[g]	<1	3
Turbidity	SM2130 B	NTU[h]	0.21	5

a. milligrams calcium carbonate per liter = mg CaCO3/L
b. milligrams per liter = mg/L.
c. milliequivalents per liter = me/L
d. Recommended/Upper/Short-Term Secondary MCLs.
e. Secondary MCL.
f. Umhos/cm = µS/cm.
g. Threshold Odor Number = T.O.N.
h. Nephelometric Turbidity Units = NTU

Table 4-9
Inorganic Minerals Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
Aluminum	EPA 3010A	ug/L[d]	<50	1,000
Antimony	EPA 200.8	ug/L	<6	6
Arsenic	EPA 200.8	ug/L	<2	10
Barium	EPA 200.8	ug/L	<100	1,000
Beryllium	EPA 200.8	ug/L	<1	4
Cadmium	EPA 200.8	ug/L	<1	5
Chromium (Total)	EPA 200.8	ug/L	<1	50
Copper	EPA 200.8	ug/L	<50	1,300[a]
Fluoride	SM4500 F C	mg/L	0.2	2.0[b]
Iron	EPA 3010A	ug/L	<100	300[b]
Lead	EPA 200.8	ug/L	<5	15[a]
Manganese	EPA 3010A	ug/L	**130**	50[b]
Mercury	EPA 245.1	ug/L	<1	0.002
Nickel	EPA 200.8	ug/L	<10	0.1
Nitrate as $N0_3$ (as N)	SM4500 NO3 E	mg/L[e]	<1	45 (10 as N)
Nitrite (as nitrogen)	SM4500 NO2 B	mg/L	<0.1	1 (as N)
Nitrate + Nitrite (sum as nitrogen)	Calculated	mg/L	<1	10 (as N)
Silver	EPA 200.8	ug/L	<10	—
Selenium	EPA 200.8	ug/L	<5	50

Table 4-9
Inorganic Minerals Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
Thallium	EPA 200.8	ug/L	<1	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. Atomic weight of nitrogen is 14.0067 and the molar mass of nitrate anion (NO_3^-) is 62.0049 g/mole. To convert nitrate to nitrate-nitrogen: x mg/L nitrate (NO_3) X 0.2259 = y mg/L nitrate nitrogen (NO_3 – N). And to convert nitrate nitrogen: x mg/L(NO_3 – N) X 4.4269 = y mg/L nitrate (NO_3).
d. Microgram per liter = µg/L
e. Milligram per liter = mg/L

Table 4-10
Volatile Organic Compounds (VOCs) Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
1,1,1,2-Tetrachloroethane	EPA 524.2	ug/L[b]	<0.50	—
1,1,1-Trichloroethane	EPA 524.2	ug/L	<0.50	200
1,1,2,2-Tetrachloroethane	EPA 524.2	ug/L	<0.50	—
1,1,2-Trichloroethane	EPA 524.2	ug/L	<0.50	5
1,1-Dichloroethane	EPA 524.2	ug/L	<0.50	5
1,1-Dichloroethene	EPA 524.2	ug/L	<0.50	6
1,1-Dichloropropene	EPA 524.2	ug/L	<0.50	—
1,2,3-Trichlorobenzene	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 (total)	EPA 524.2	ug/L	<0.50	0.5
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	—
2-Butanone(MEK-EPA 8260)	EPA 524.2	ug/L	<5.0	—
2-Chlorotoluene	EPA 524.2	ug/L	<0.50	—
4-Chlorotoluene	EPA 524.2	ug/L	<0.50	—
4-Methyl-2-Pentanone(MIBK)	EPA 524.2	ug/L	<5.0	—

Table 4-10
Volatile Organic Compounds (VOCs) Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
Benzene	EPA 524.2	ug/L	<0.50	1
Bis(2-chloroethyl)ether	EPA 524.2	ug/L	<5.0	—
Bromobenzene	EPA 524.2	ug/L	<0.50	—
Bromodichloromethane	EPA 524.2	ug/L	<0.50	—
Bromodichloromethane	EPA 524.2	ug/L	<0.50	—
Bromoform	EPA 524.2	ug/L	<0.50	—
Bromomethane	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	<0.50	80[a]
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	—
Dibromochloromethane	EPA 524.2	ug/L	<0.50	—
Dibromomethane	EPA 524.2	ug/L	<0.50	—
Dichlorodifluoromethane	EPA 524.2	ug/L	<0.50	—
Ethylbenzene	EPA 524.2	ug/L	<0.50	300
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
n-Butylbenzene	EPA 524.2	ug/L	<0.50	—
n-Propylbenzene	EPA 524.2	ug/L	<0.50	—
Naphthalene	EPA 524.2	ug/L	<0.50	—
p-Isopropyltoluene	EPA 524.2	ug/L	<0.50	—
sec-Butylbenzene	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

Table 4-10
Volatile Organic Compounds (VOCs) Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCL
Vinyl Chloride	EPA 524.2	ug/L	<0.50	0.5
Xylenes (m+p)	EPA 524.2	ug/L	<0.50	—
Xylenes (ortho)	EPA 524.2	ug/L	<0.50	—
Xylenes (Total)	EPA 524.2	ug/L	<0.50	1,750

a. MCL reported is for Total trihalomethanes, which is a sum of Bromodichloromethane, Bromoform, Chloroform and Dibromochloromethane.
b. Microgram per liter = μg/L

Table 4-11
Radiochemistry Water Quality Results – Well 8

Constituent	Analytical Method	Units	Well 8 Groundwater (Sample from January 18, 2012)	California Drinking Water MCLs
Gross Alpha	EPA 900.0	pCi/L	21.9 +/- 3.43	15[a]
Total Alpha Radium (226)	EPA 903.0	pCi/L	0.249 +/- 0.292	3
Uranium	EPA 908.0	pCi/L	**21.7 +/- 2.70**	20
RA 228	Ra – 05	pCi/L	0.000 +/- 0.534	2

pCi/L = picocuries per liter
a Subtract the uranium activity from the gross alpha measurement to determine actual compliance with the gross alpha MCL.

Table 4-12
Field Water Quality Parameters – Well 8

Sample Date/Time	Temperature (°F)	pH	Conductivity (μS/cm)	TDS (mg/L)	Salinity (⁰/₀₀)
1/17/2013 13:35	67.8	6.83	756	370	0.4
1/17/2013 13:40	67.8	6.89	757	369	0.4
1/17/2013 13:45	68.0	7.01	756	369	0.4
1/18/2013 9:25	66.5	6.83	805	392	0.4
1/18/2013 9:30	66.7	7.02	759	370	0.4
1/18/2013 9:35	67.4	7.14	765	373	0.4
1/18/2013 9:40	67.8	7.16	761	372	0.4

Water quality results show that all constituents sampled, with the exception of uranium, are below U.S. EPA and State of California primary MCLs. Inorganic constituents detected in water quality samples included fluoride and manganese. Fluoride was detected below the applicable MCL, but manganese, detected at 130 ug/L, exceeds the secondary MCL of 50 ug/L. No VOCs were detected. Gross alpha and uranium were detected at elevated concentrations. In order to determine compliance with the gross alpha MCL, the uranium activity is subtracted from the gross alpha measurement (21.9 – 21.7 = 0.2 pCi/L). This result is below the gross alpha MCL. However, the uranium concentration detected at 21.7 +/- 2.70 pCi/L exceeds the California drinking water MCL of 20 pCi/L. As the range of the analytical error may result in a concentration less than the MCL, additional sampling shall be performed to increase statistical confidence in the result. Periodic water quality sampling shall be conducted for Well 8 to ensure that uranium concentrations are declining or have stabilized. These radionuclides are naturally occurring in bedrock aquifers in San Diego County. Radionuclides should be periodically monitored to ensure detections below MCLs.

4.3 Significance of Impacts Prior to Mitigation

Because all water quality constituents are below federal and California MCLs for Well 6b, the impact of the Project with respect to groundwater quality is considered less than significant. As uranium was detected at the MCL in the Well 8 water quality sample, the impact of the Project could be significant if Well 8 is used for potable supply.

4.4 Mitigation Measures and Design Considerations

No mitigation measures are required or recommended for Well 6b because water quality constituents were all found to be below the applicable primary and secondary MCLs. Additional sampling is recommended for Well 8 to confirm exceedance of the MCL for uranium. If Well 8 continues to exceed drinking water MCL for uranium and is required for potable supply, wellhead treatment would be required to serve the well water as drinking water. No treatment would be required for Well 8 for non- potable use.

4.5 Conclusions

Results of water quality analyses show that all constituents sampled for are below U.S. EPA and State of California MCLs for Well 6b, and the impact of the Project with respect to groundwater quality would be less than significant under the California Environmental Quality Act. Results of water quality analyses show that all constituents sampled for are below primary U.S. EPA and State of California MCLs for Well 8, except for uranium, which was detected above the MCL. As the range of the analytical error for uranium may result in a concentration less than the MCL, additional sampling should be performed. If additional analysis indicates Well 8 continues to exceed the drinking water MCL for uranium, wellhead treatment would be required to use the well water as drinking water. No treatment would be required for Well 8 for non-potable use.

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5.0 SUMMARY OF PROJECT IMPACTS AND MITIGATION

As presented in Section 2.4, the peak construction water demand for the Project is estimated to range from 192,000 to 296,000 gpd over a period of approximately 60 workdays. During this period, on-site Wells 6a, 6b, and 8 will be pumped at their maximum tested capacity, which, combined would be approximately 182,880 gpd. After Project clearing, grubbing, grinding and grading is completed, construction water demand is estimated to be range from 18,000 to 22,000 gpd for the remainder of the 1-year Project buildout. This estimate assumes that a non-toxic tackifier will be used to stabilize site soils, thereby minimizing water use for dust control. Considering the nature and phasing of these activities, the total construction water demand is expected to be approximately 19.4 million gallons, or 59 acre-feet. Of the total construction demand, 44 acre-feet will be supplied from on-site supply wells with up to 16 acre-feet supplied from permitted off-site sources.

During Project operation, water demand will be limited to CPV panel washing, potable supply, and yearly application of a soil binding agent. The annual operational water use is estimated to be 2.83 million gallons or 8.7 afy. Nine afy is equivalent to the quantity of water that, on average, is consumed by 18 households. As tested, Wells 6a, 6b and 8 have sufficient capacity to meet all operational water demands of the Project along with its existing uses and reasonably foreseeable future projects.

The following presents a summary of the potential groundwater impacts evaluated for the Project including a discussion of reduction of groundwater storage, well interference, groundwater-dependent habitat, and water quality.

5.1 50% Reduction in Groundwater Storage

As presented in Section 3.1, a soil moisture balance analysis was performed to evaluate the impacts of the Project and the surrounding off-site users within 0.5-mile radius of Wells 6a, 6b and 8. The analysis indicates that the volume of groundwater in storage would remain above the 50% significance threshold. Assuming a combined water demand of existing conditions, the Project, full General Plan buildout, construction and operation of the Rough Acres Ranch Campground Project, and the operational demands of the Tule Wind Project, the minimum volume of groundwater in storage over the 30-year period analyzed was approximately 70% of the maximum groundwater storage capacity in the vicinity of Wells 6a and 6b. Under these conditions, there appears to be a long-term drawdown in storage for Scenario 3a, which would meet the County's significance threshold. This apparent long-term decline in groundwater storage is, however, an artifact of the anomalously low precipitation values measured at the Tierra del Sol rain gauge. This gauge records a long term average precipitation of 10.5 inches in the vicinity of the Project site. As discussed above in section 2.1, this precipitation record is not representative of the long-term precipitation records recorded at other nearby stations, and does not fall within either the USGS or San Diego County calculated isohyets for the region, which average 14 and 13.5 inches respectively. When the Campo rain gauge data are scaled down from the actual annual average of 15.4 inches per year, to an average annual precipitation of 13.5 inches per year, based on the County precipitation map, the annual average recharge is 57 acre-feet per year within a 0.5 mile radius of Wells 6a and 6b, and no long-term drawdown is observed in the water balance calculation

Additionally, the estimated groundwater storage of the resource study area employed a conservative saturated thickness of alluvium, residuum, and fractured rock of 10 feet, 20 feet, and 500 feet, respectively for Well 8, and 20 feet, 20 feet, and 500 feet, respectively for Wells 6a and 6b. These thicknesses underestimate the actual volume of groundwater in storage.

Finally, the water balance analyses performed in section 3.1 is conservatively constrained to a 0.5 mile radius around the pumping wells. Typically, this type of analysis is conducted for an entire watershed, but the County requested the analysis be restricted in area based on the short term peak construction demand from these wells. The water balance analysis assumes that the only recharge to the area is provided by precipitation, and that there is no subsurface recharge. While this assumption may hold for a groundwater basin, it does not hold for a 0.5 mile radius circle within a basin.

Based on the above analyses, the Project will not exceed the 50% reduction in groundwater storage threshold and other cumulative groundwater demands will be met. Therefore, groundwater impacts to storage will be less than significant.

5.2 Well Interference

As presented in Section 3.2, drawdown at the nearest property line (439 feet south) as a result of combined Project site pumping from Wells 6a and 6b is predicted to be 7.5 feet after 60 days of pumping, 6.0 feet after 1 year of pumping, and 3.3 feet after 5 years of pumping. As the nearest property line borders an undeveloped parcel, well interference with the parcel would only be applicable at full general plan buildout (i.e. the parcel is developed). Drawdown at the nearest residential well (1,742 feet) as a result of Project pumping from Wells 6a and 6b is predicted to be 4.3 feet after 60 days of pumping, 4.6 feet after 1 year of pumping, and 2.6 feet after 5 years of pumping. Drawdown at the nearest off-site well (McCain Conservation Camp Well) as a result of Project pumping from Well 8 is predicted to be 2.7 feet after 60 days of pumping, 4.1 feet after 1 year of pumping, and 3.5 feet after 5 years of pumping. Because the predicted drawdowns would be less than 20 feet, the groundwater demands of the Project would be considered to have a less-than-significant impact with respect to well interference, based on the County of San Diego well interference threshold (County of San Diego 2007).

5.3 Groundwater Dependent Habitat

As presented in Section 3.2.1.2, there are 7 vegetation communities identified on the Project and in the Project vicinity that may potentially depend on groundwater. These vegetation types include species with specific rooting depths that either intercept water the near surface or have deep tap roots that extend to the alluvial water table. Of the 7 vegetation communities only the coast live oak woodland and tamarisk scrub can likely access water from the alluvial aquifer. The other vegetation communities have shallow root systems and are dependent on surface water or perched groundwater above the water table of the alluvial aquifer. The nearest coast live oak woodland and tamarisk scrub are located 447 feet and 700 feet, respectively from Wells 6a and 6b. Based on the Hantush solution, peak Project well production (occurs during first 60 days of construction) results in a drawdown in the aquifer of 7.5 feet and 6.3 feet at distances of 439 feet and 700 feet from pumping Wells 6a and 6b. At the end of Project construction, drawdown in the aquifer is estimated to be 5.6 feet and 5.4 feet at distances 447 feet and 700 feet from Wells 6a and 6b. After 5 years, which includes 1 year of project construction and 4 years of operation, drawdown in the aquifer is 3.3 feet and 3.2 feet at distances of 447 feet and 700 feet from Wells 6a and 6b (Table 3-20). Summing the current average depth to water of 14 feet bgs and the additional 7.5 feet of maximum Project drawdown, the projected water table may be as low as 21.5 feet bgs at the nearest coast live oak woodland. Summing the current average depth to water of 14 feet bgs and the additional 6.3 feet of maximum Project drawdown, the projected water table may be as low as 20.3 feet bgs.

The historical low groundwater level in the vicinity of the oak woodland and tamarisk scrub 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. Therefore, routine biological monitoring and aquifer water level monitoring for the duration of the one year Project construction period will serve as a means to continually assess health of the groundwater dependent habitat as described in detail in the GMMP.

Big sagebrush scrub is the only potentially groundwater dependent habitat mapped near Well 8. Big sagebrush scrub requires groundwater to be present in shallow soil horizons and therefore is dependent on surface water or perched groundwater. The alluvial water table near Well 8 is currently at 16 feet bgs. Thus, the roots of the big sagebrush scrub do not intercept the alluvial aquifer and no impact to the big sagebrush scrub is expected.

5.4 Water Quality

As presented in Section 4.0, water quality analysis of Well 6b indicates that all constituents sampled are below U.S. EPA and State of California MCLs; therefore, groundwater impacts from water quality for Well 6b would be less than significant.

As uranium was detected above the California MCL in the water quality sample from Well 8, the Project groundwater quality impacts could be significant if Well 8 is used for potable supply. Groundwater quality impacts for Well 8 would be less than significant if the water is used only for non-potable supply.

5.5 Mitigation Measures

As the analysis contained herein is based on limited Project production well testing, monitoring will be conducted to ensure that County well interference and groundwater-dependent habitat significance thresholds are not exceeded.

Well Interference: A network of on-site and off-site observation wells has been established to monitor water levels. Pressure transducers will remain in select on-site and off-site wells to record water level fluctuations. In addition to the existing on-site and off-site wells, a new fractured rock monitoring well (MW-SPB) is proposed to be installed approximately 350 feet south of Wells 6a and 6b to monitor water levels in the fractured rock aquifer. A maximum drawdown of 18 feet below the water level baseline at MW-SPB will be allowed at this well during the 60 days of peak project production. After 1 year of production, a maximum drawdown of 14 feet will be allowed at this well. This protective threshold will prevent drawdown of 10 feet below the water level baseline at the nearest residential parcel property line located 1,742 feet from the pumping wells based on distance drawdown calculations using the Hantush solution.

The nearest off-site well to pumping well, Well 8, is the McCain Conservation Camp Well, located approximately 1,800 feet southeast of Well 8, which will likely be accessible for monitoring during pumping at Well 8. The McCain Conservation Camp Well will serve as the Well 8 monitoring point for compliance with groundwater drawdown guidelines established by the County. It will be equiped with a pressure transducer in the spring of 2014, which will record water level measurements for approximately 1 year prior to the onset of Project-related groundwater extraction. Transducer accuracy will be confirmed through manual water level measurements recorded with a sounder. The measurements collected from the McCain Conservation Camp Well over this year will be used to establish a water level baseline and capture water level patterns generated by pumping of this well. An understanding of these patterns will likely allow for this well's continued use as a monitoring well despite the possibility that it may be pumped over the duration of the Project. During pumping at Well 8, a maximum drawdown of 10 feet below the pumping baseline will be allowed at the McCain Conservation Camp Well. This threshold takes into account the County guidelines for limiting drawdown in both fractured rock and alluvial aquifers.

Groundwater Dependent Habitat: The network of groundwater observation wells monitored for well interference will also be used to monitor potential effects of water table decline on groundwater dependent habitat. An additional monitoring well (MW-O) is proposed to monitor drawdown in the alluvial aquifer in the vicinity of pumping Wells 6a and 6b. The historical low groundwater level in the vicinity of the oak woodland is not known over the period corresponding to the lifespan of mature oaks. This lack of historical water level data precludes determination of a water level threshold 3 feet below the historical low. Therefore, routine biological monitoring of the oak woodland will be carried out quarterly during the 1 year Project construction period. If a Certified Arborist or Registered Professional Forester observes an impact to the oak woodland after this period, monitoring will continue in years 2 through 5 following initiation of Project-related groundwater extraction. Biological monitoring procedures are described in the GMMP. If an ISA Certified Arborist or Registered Profession Forester observes that no impact to the oak woodland has occurred over the construction period, biological monitoring of the oak woodland will cease. In addition to biological monitoring a water level threshold of 10 feet of drawdown below baseline at proposed monitoring well (MW-O) will be established to protect the oaks' ability to continually access groundwater from the alluvial aquifer.

Water Quality: If Well 8 is used for potable supply, additional water quality testing for radiochemistry shall be performed to evaluate that uranium levels. If additional analysis indicates Well 8 continues to exceed the drinking water MCL for uranium, wellhead treatment would be required to use the well water as drinking water. No treatment would be required for Well 8 for non-potable use.

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7.0 LIST OF PREPARERS AND PERSONS AND ORGANIZATIONS CONTACTED

This report was prepared by Dudek Hydrogeologists Trey Driscoll, PG, CHG; Patrick Rentz; Dylan Duvergé; and Steve Stuart, PE. Dudek Hydrogeologist Stephen K. Dickey, PG, CHG, CEG, provided review assistance and coordination with the County as the County-approved hydrogeologist. Peter Quinlan, RG and principal-in-charge; and Jill Weinberger, PhD, PG, provided peer review of this report. Fieldwork was conducted by the above hydrogeologists and by GLA Geologist Kyle Welchans. Graphics and GIS mapping and analyses were provided by Patrick Rentz and Dylan Duvergé. GLA Principal Geologist, Sarah Battelle provided support assistance and coordination with Tule and Rough Acres Ranch Campground Projects including coordination with the County. This report was prepared in coordination with County Groundwater Geologist James Bennett, with meteorological input from Rand Allan from the San Diego County Flood Control.

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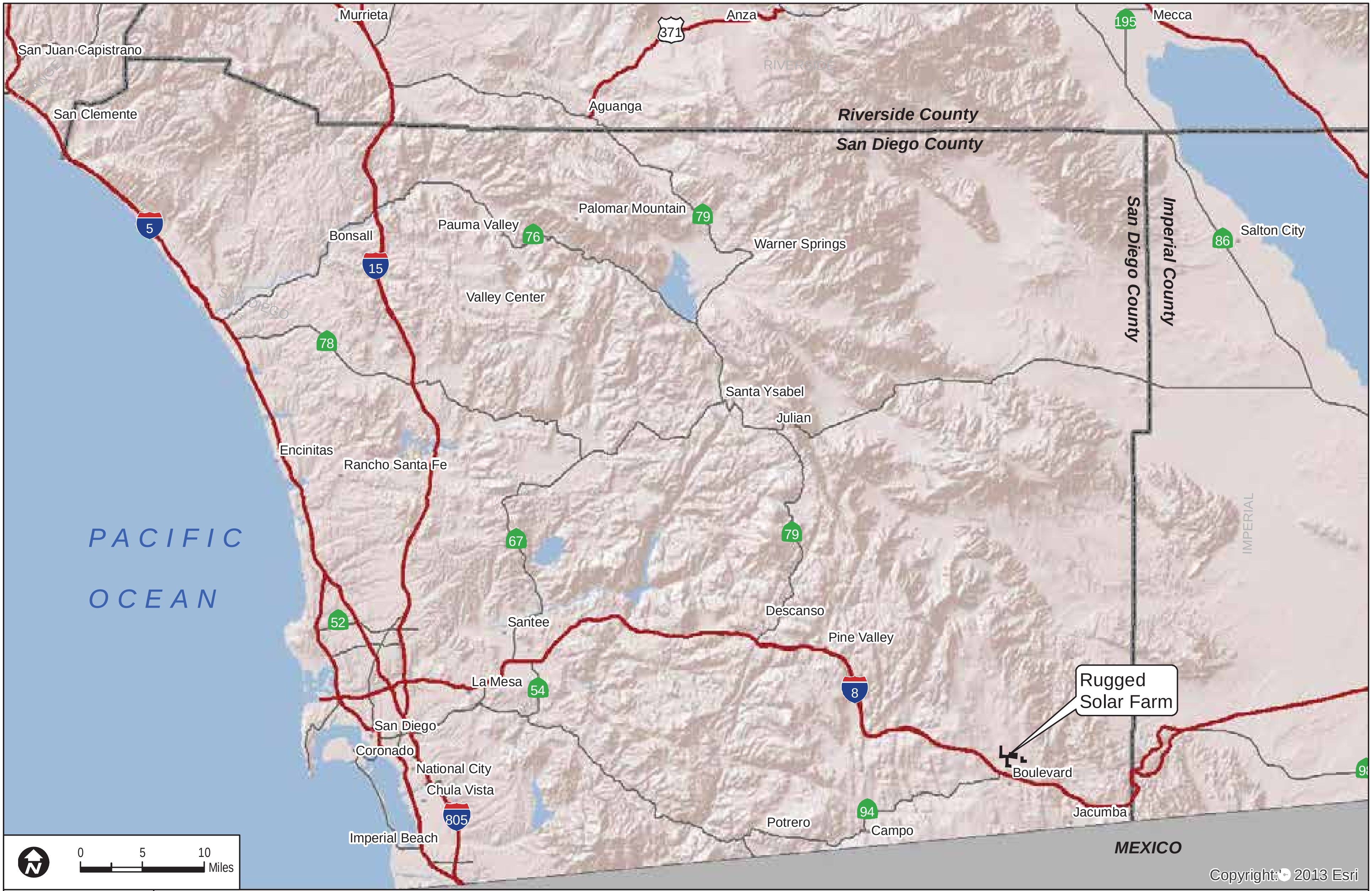

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FIGURE 1

Regional Location

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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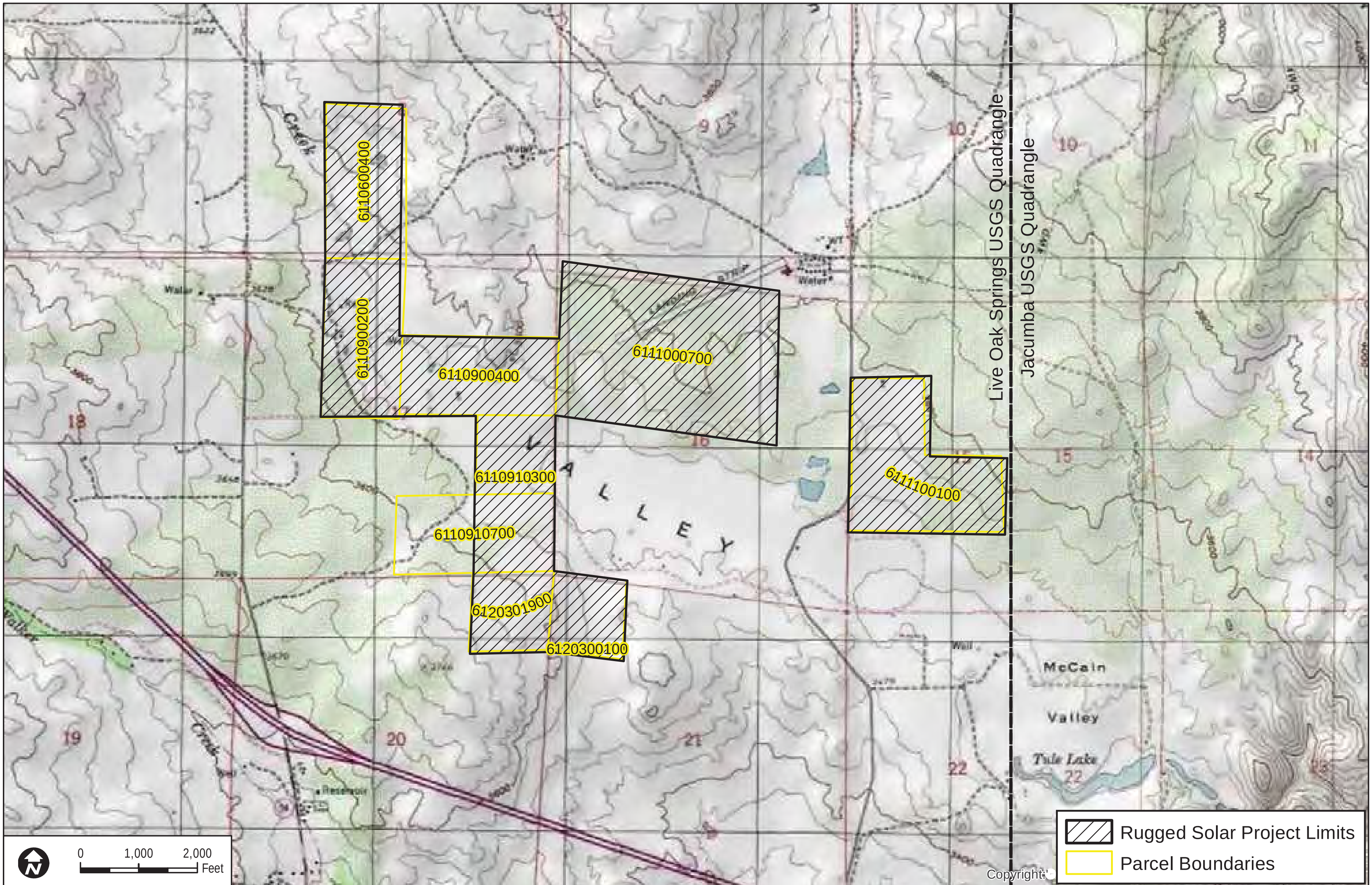

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SOURCE: SanGIS 2012; USGS 7.5' Topographic Maps

FIGURE 2

Vicinity Map

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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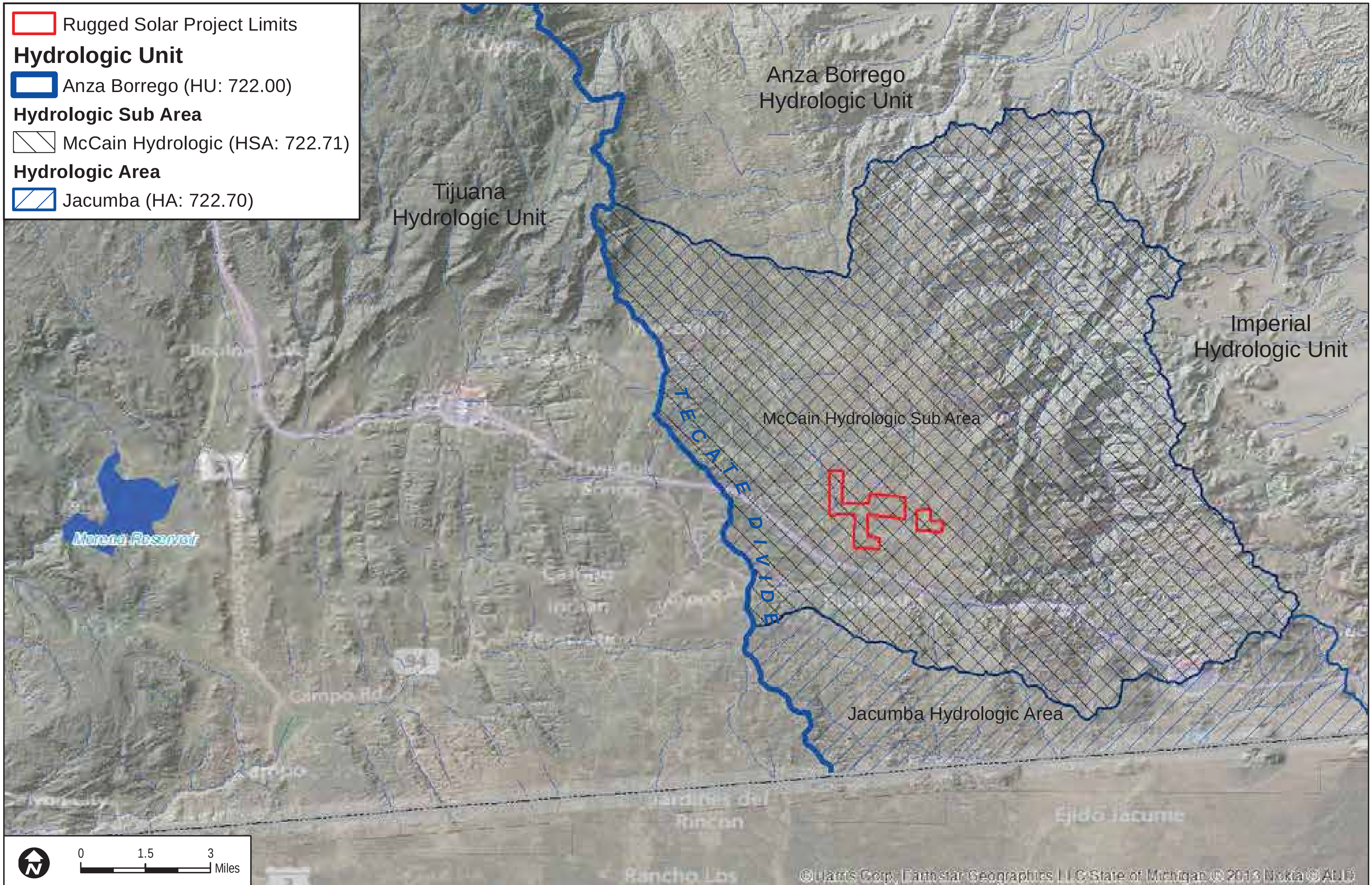

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SOURCE: U.S. Geological Survery National Hydrography Dataset (USGS 2012)

FIGURE 3

Hydrologic Areas

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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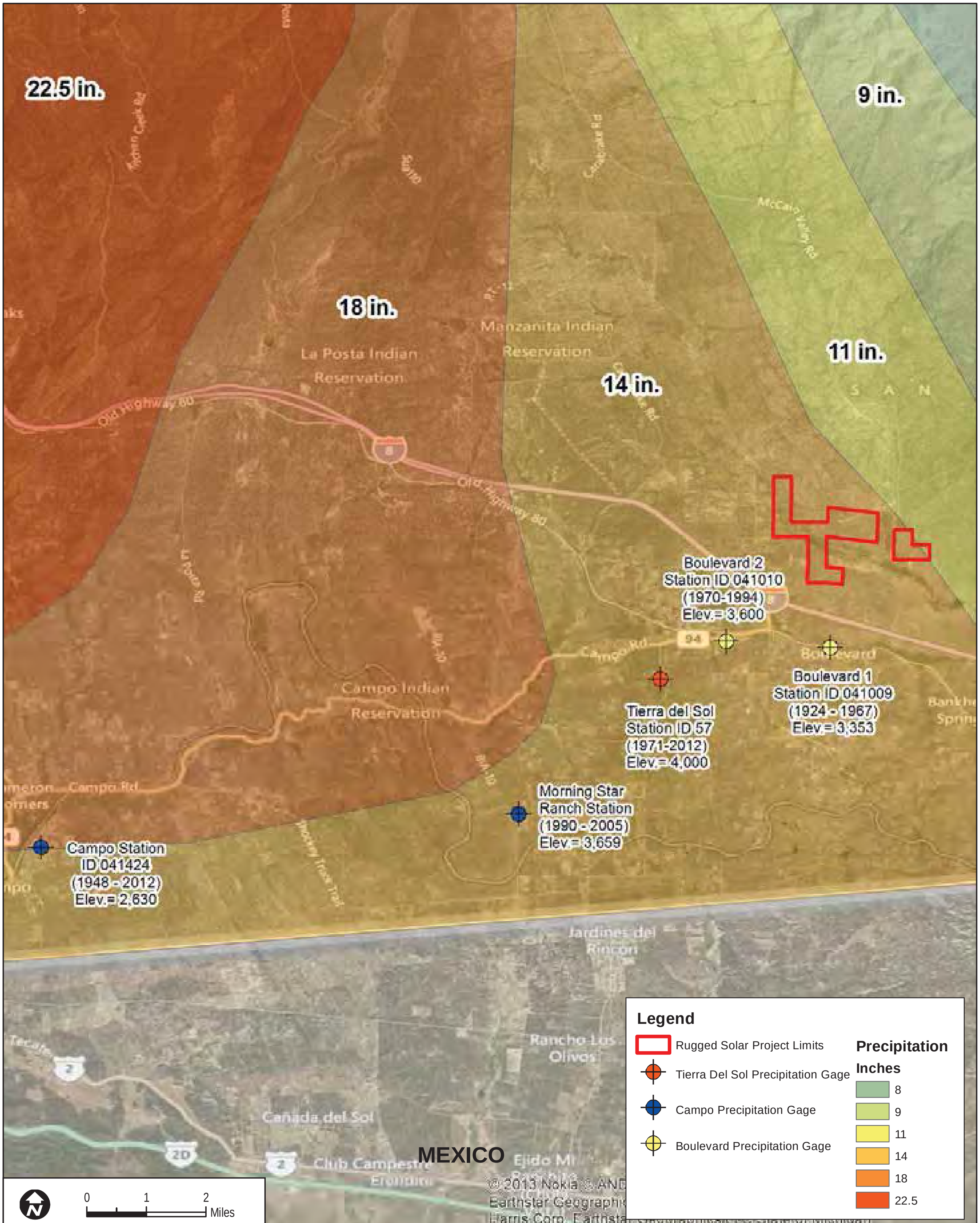

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SOURCE: BING MAPS, USGS PRECIPITATION DATA

FIGURE 4

Regional Mean Annual Precipitation

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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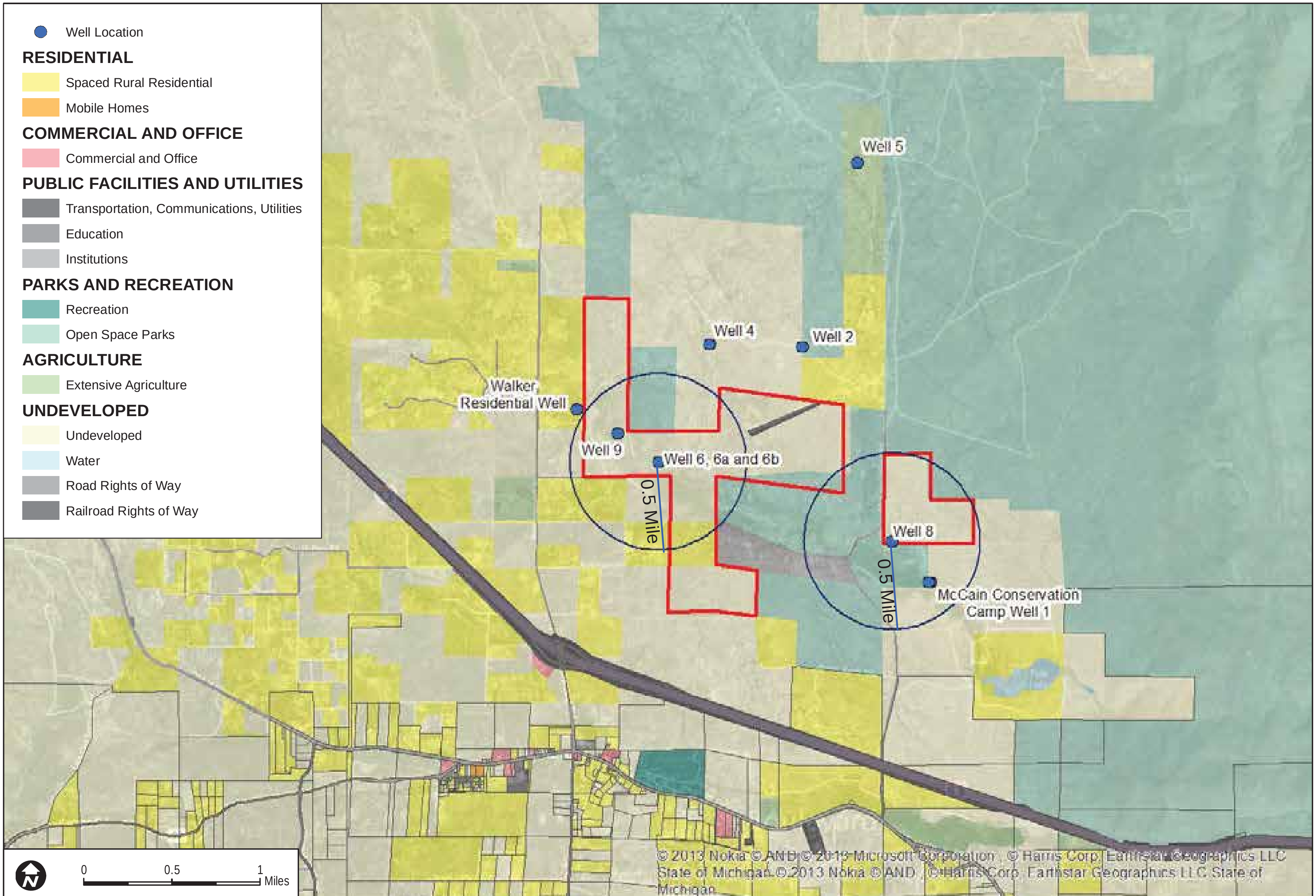

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SOURCE: Bing Maps, SanGIS

FIGURE 5
Current Land Use

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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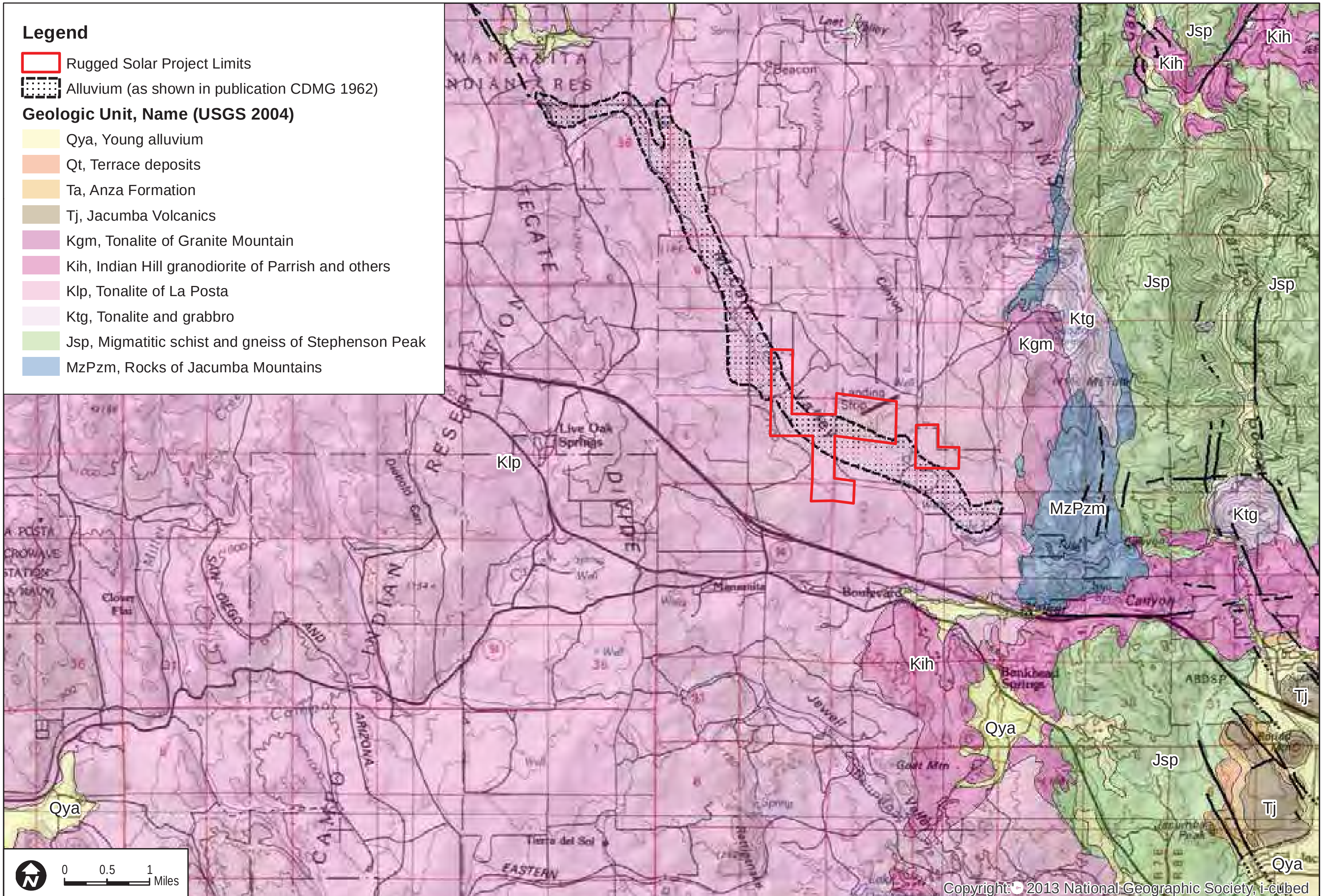

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SOURCE: USGS 2004, CDMG 1962

FIGURE 6

Regional Geologic Map

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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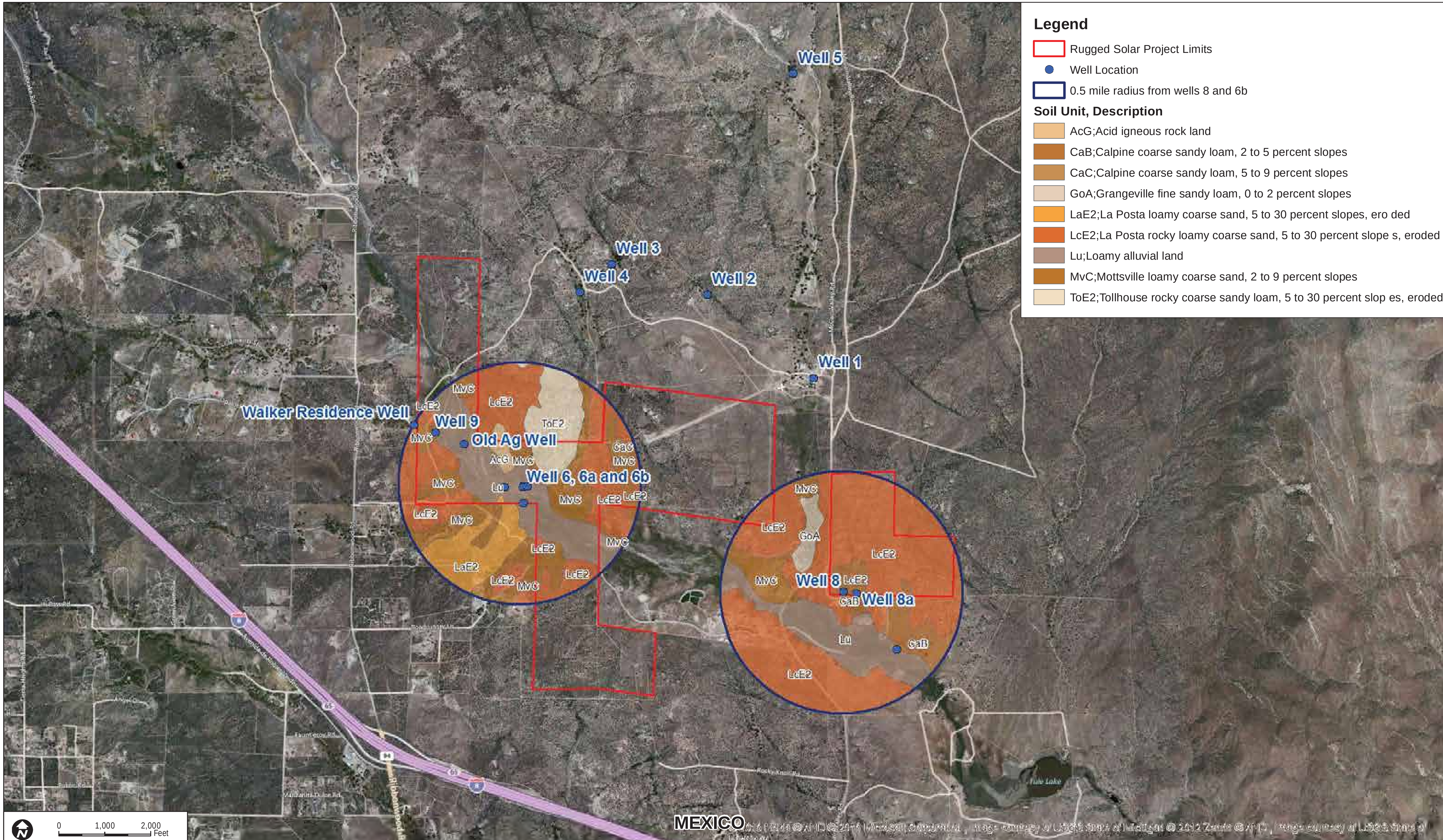

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SOURCE: Bing Maps, SanGIS 2010

FIGURE 7
Soils Map

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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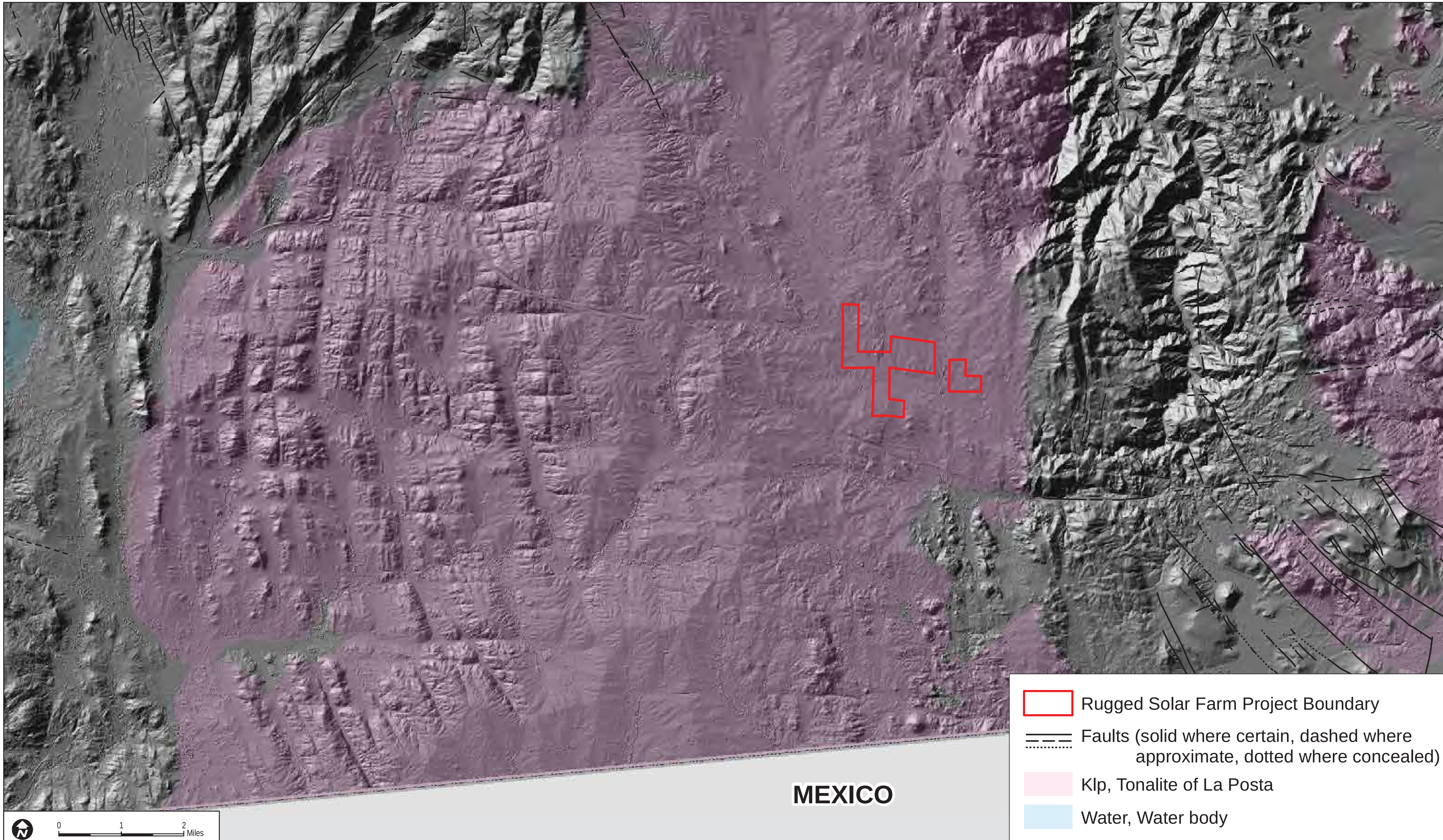

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SOURCE: NOAA

FIGURE 8
IFSAR DIGITAL ELEVATION MODEL

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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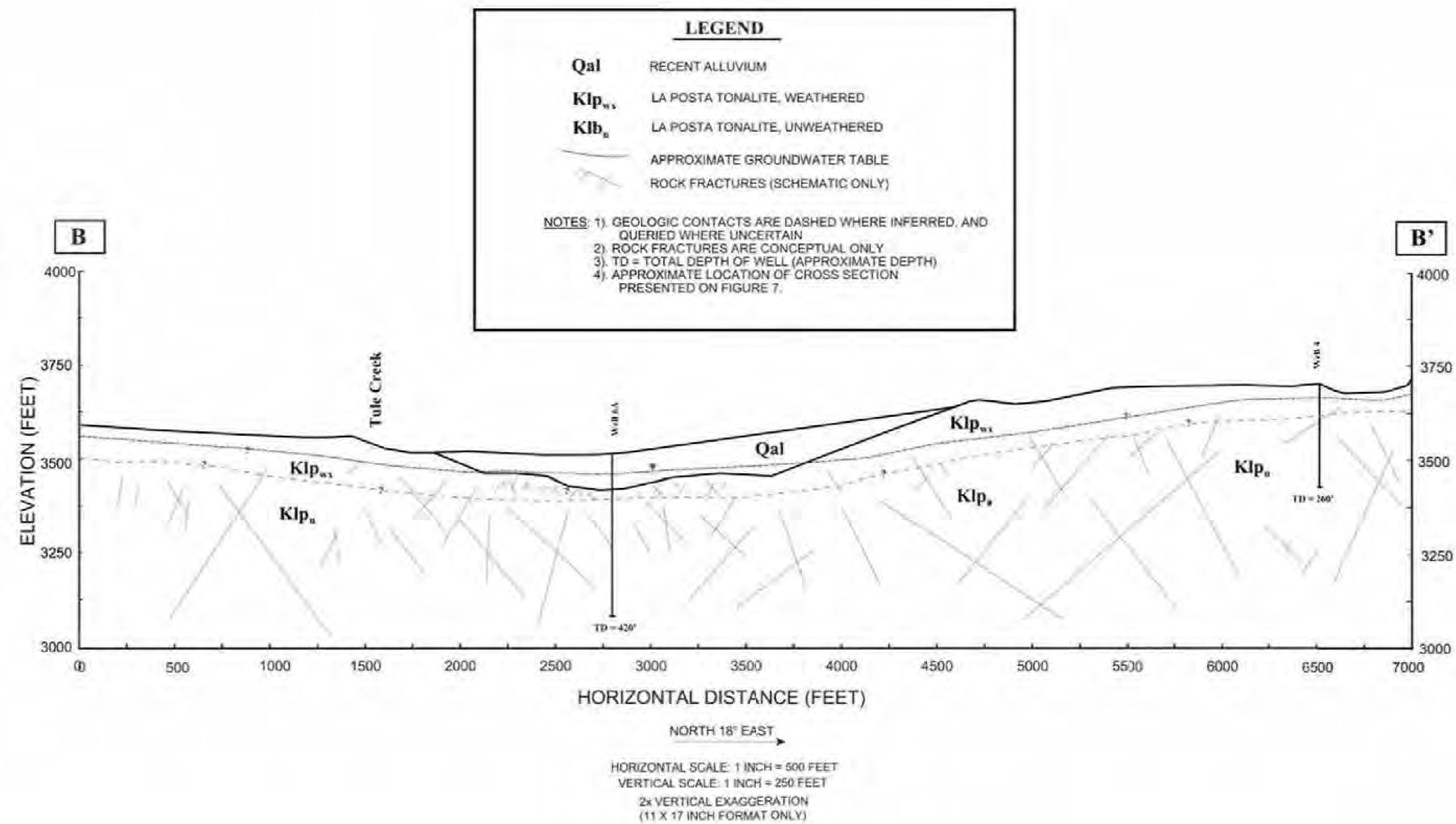

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SOURCE: USGS, 1975, 7.5' Live Oak Springs, CA Quadrangle; GLA 2012.

FIGURE 9

Conceptual Hydrogeologic Cross Section

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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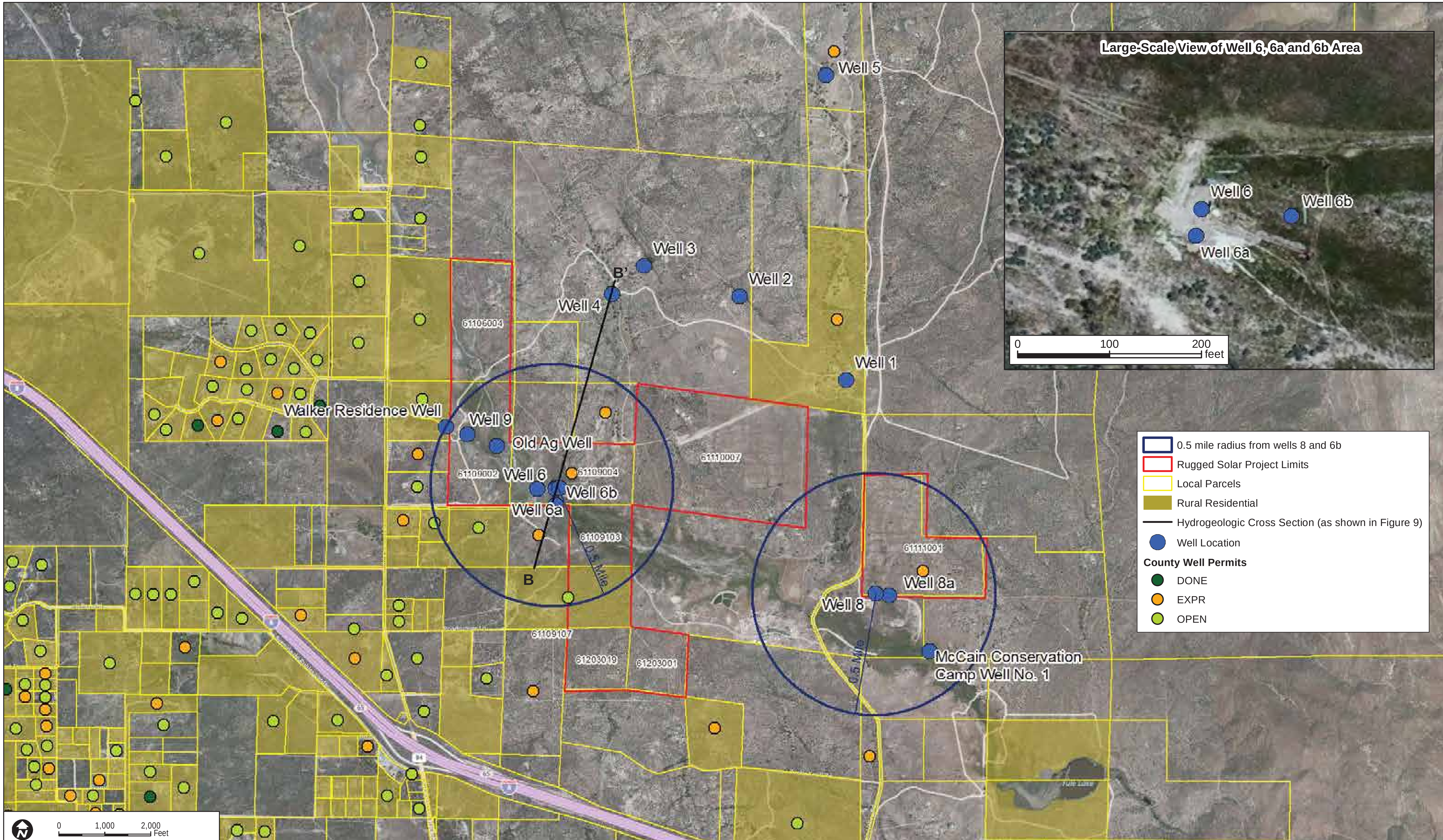

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SOURCE: SanGIS 2012, GLA 2012, SANDAG 2009

FIGURE 10

ON-SITE AND OFF-SITE WELLS

GROUNDWATER RESOURCES INVESTIGATION REPORT - RUGGED SOLAR FARM

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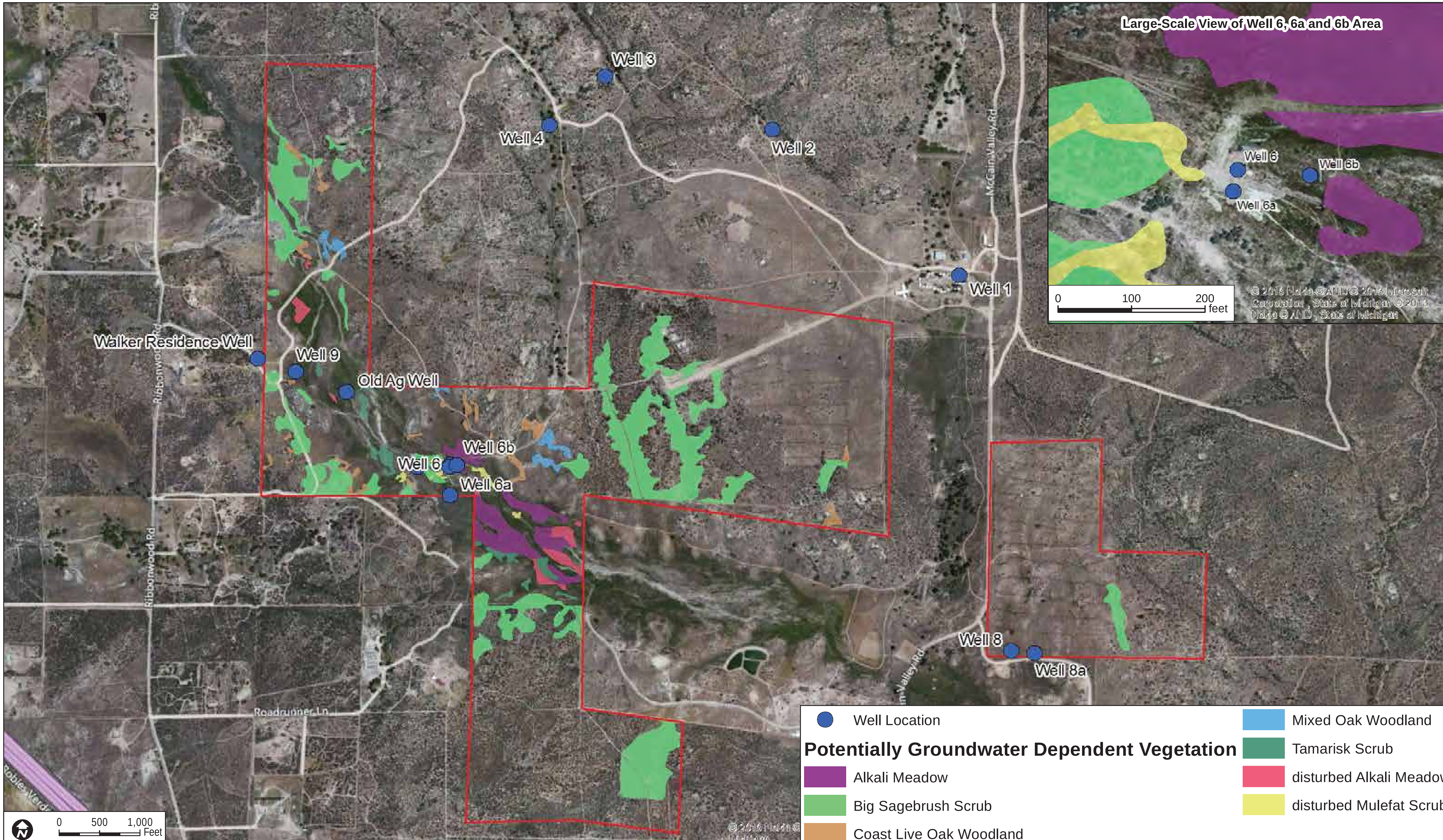

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SOURCE: BingMaps, SanGIS 2012, Dudek 2012

FIGURE 11

POTENTIAL GROUNDWATER-DEPENDENT VEGETATION

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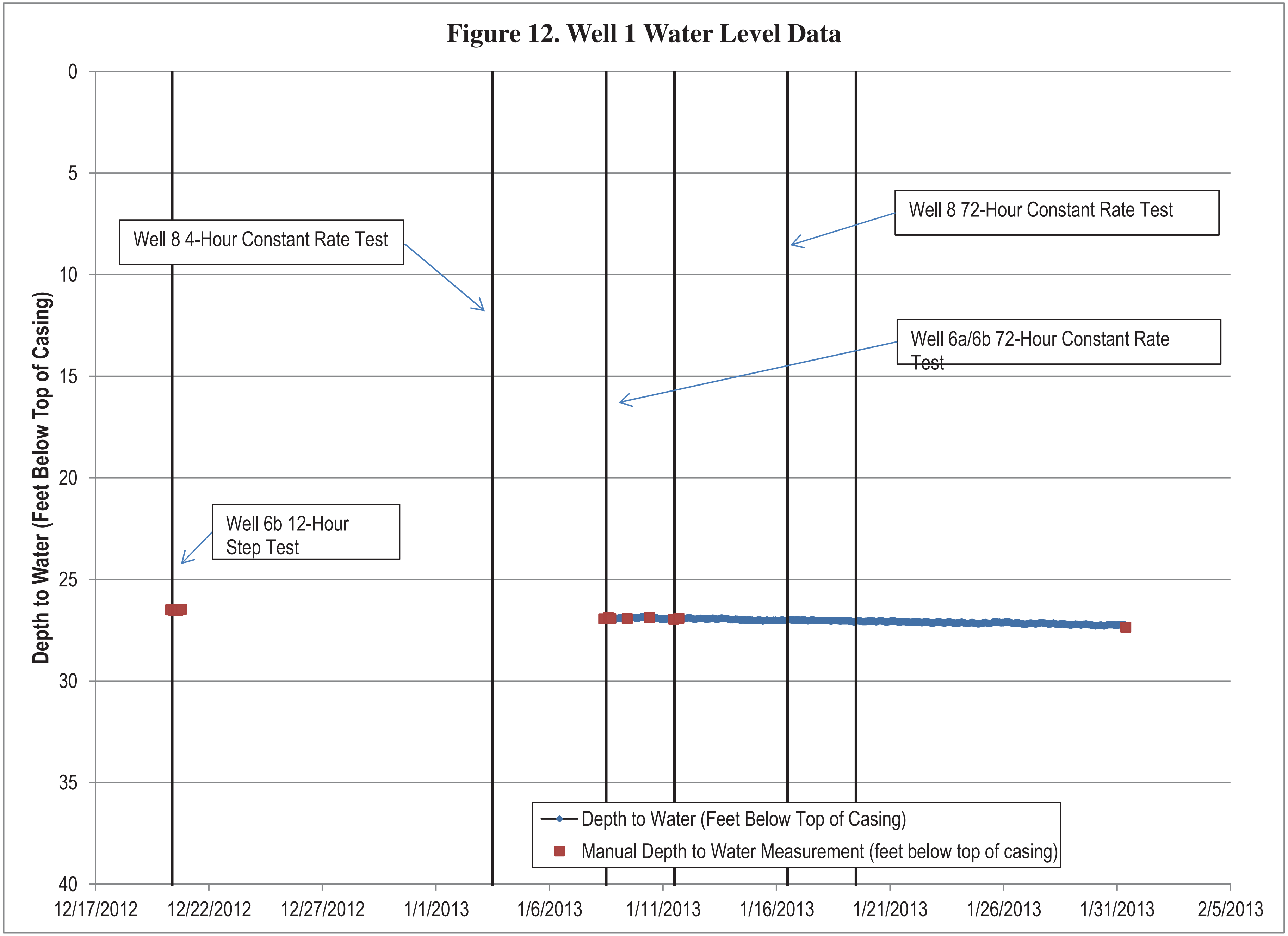

Figure 12. Well 1 Water Level Data
Depth to Water (Feet Below Top of Casing)
0
5
10
15
20
25
30
35
40
12/17/2012
12/22/2012
12/27/2012
1/1/2013
1/6/2013
1/11/2013
1/16/2013
1/21/2013
1/26/2013
1/31/2013
2/5/2013
Well 8 4-Hour Constant Rate Test
Well 8 72-Hour Constant Rate Test
Well 6a/6b 72-Hour Constant Rate Test
Well 6b 12-Hour Step Test
Depth to Water (Feet Below Top of Casing)
Manual Depth to Water Measurement (feet below top of casing)

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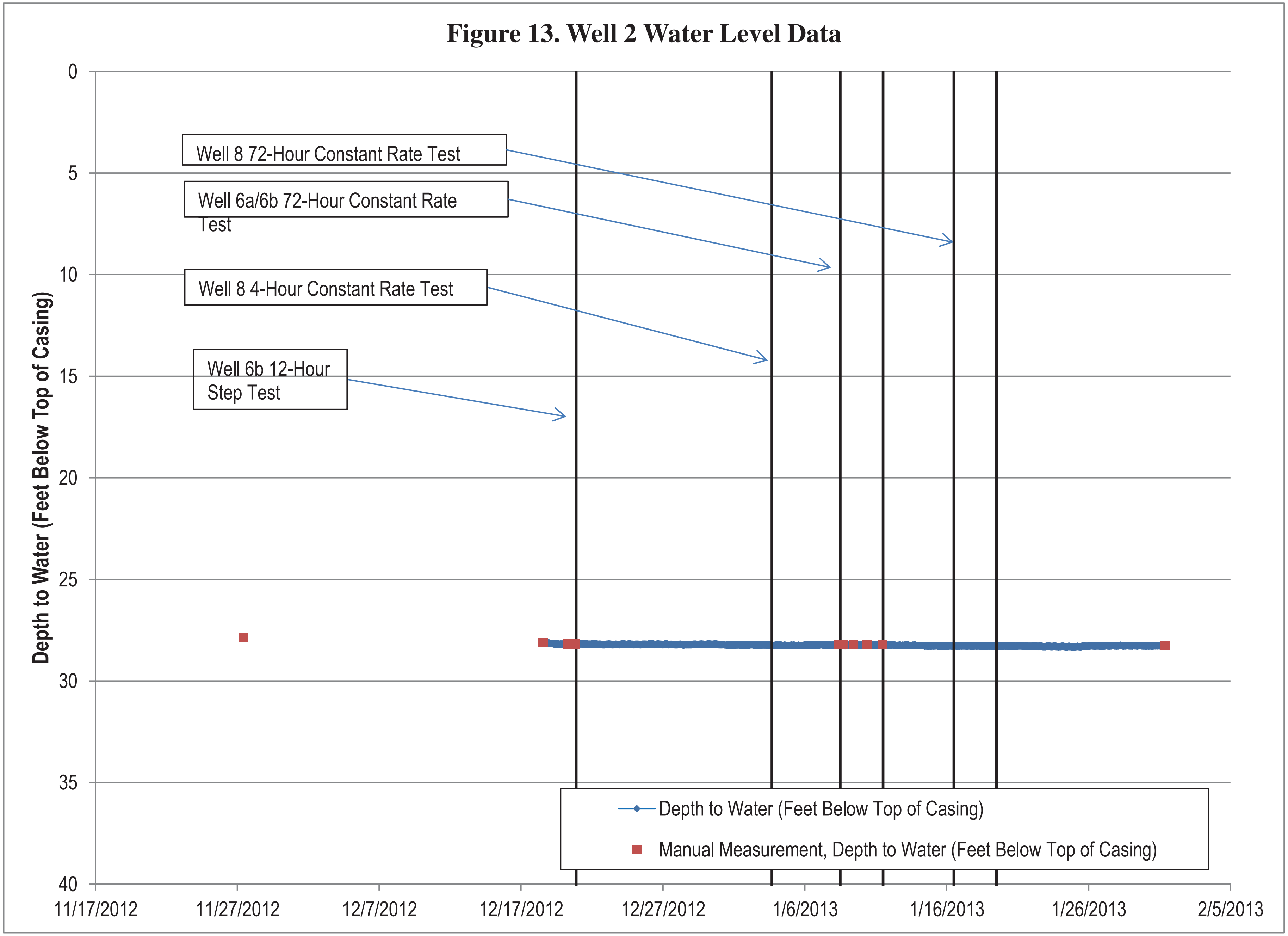
Figure 13. Well 2 Water Level Data
Well 8 72-Hour Constant Rate Test
Well 6a/6b 72-Hour Constant Rate Test
Well 8 4-Hour Constant Rate Test
Well 6b 12-Hour Step Test
Depth to Water (Feet Below Top of Casing)
0
5
10
15
20
25
30
35
40
11/17/2012
11/27/2012
12/7/2012
12/17/2012
12/27/2012
1/6/2013
1/16/2013
1/26/2013
2/5/2013
Depth to Water (Feet Below Top of Casing)
Manual Measurement, Depth to Water (Feet Below Top of Casing)

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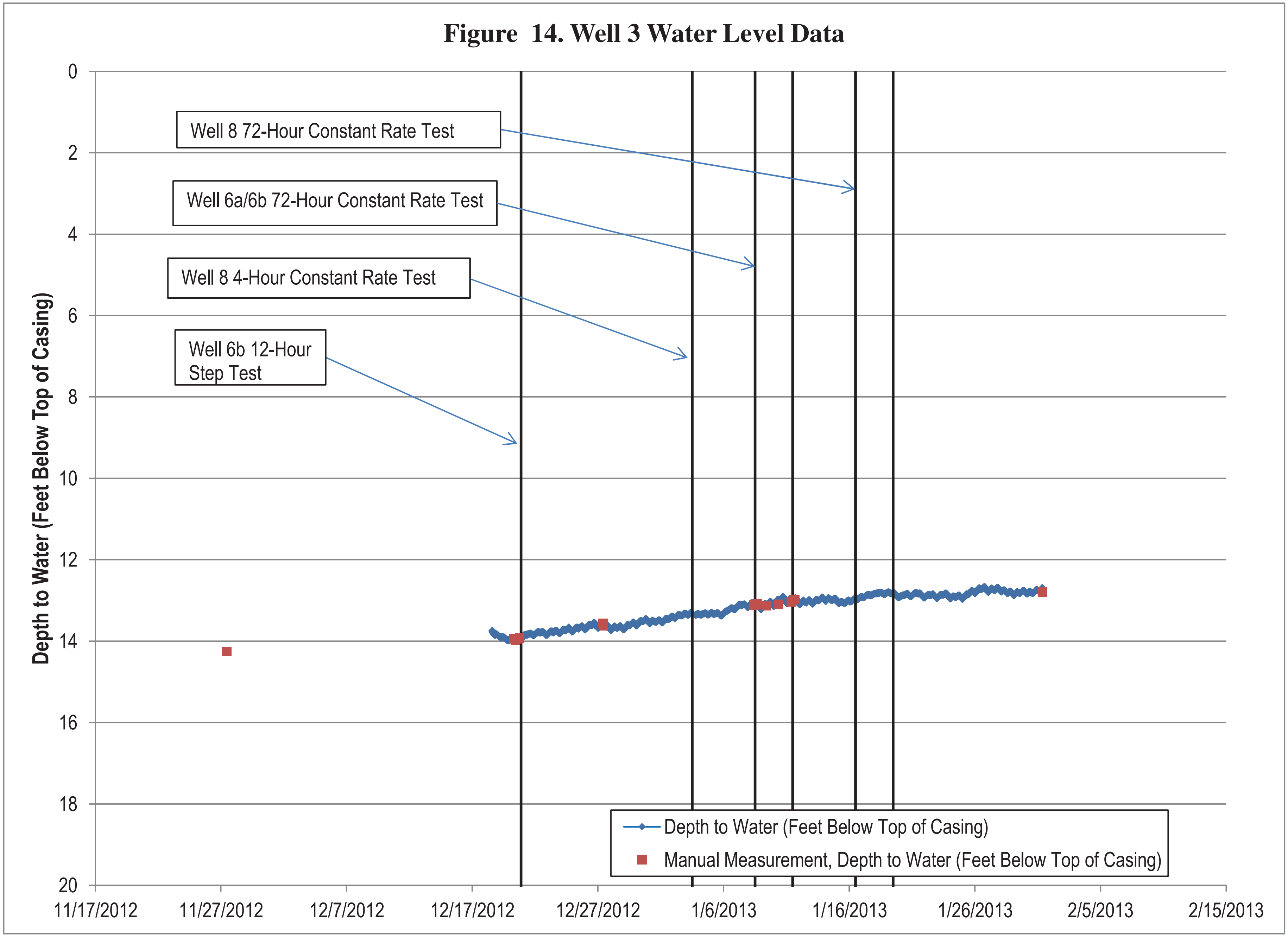
Figure 14. Well 3 Water Level Data
Well 8 72-Hour Constant Rate Test
Well 6a/6b 72-Hour Constant Rate Test
Well 8 4-Hour Constant Rate Test
Well 6b 12-Hour Step Test
Depth to Water (Feet Below Top of Casing)
0
2
4
6
8
10
12
14
16
18
20
11/17/2012
11/27/2012
12/7/2012
12/17/2012
12/27/2012
1/6/2013
1/16/2013
1/26/2013
2/5/2013
2/15/2013
Depth to Water (Feet Below Top of Casing)
Manual Measurement, Depth to Water (Feet Below Top of Casing)

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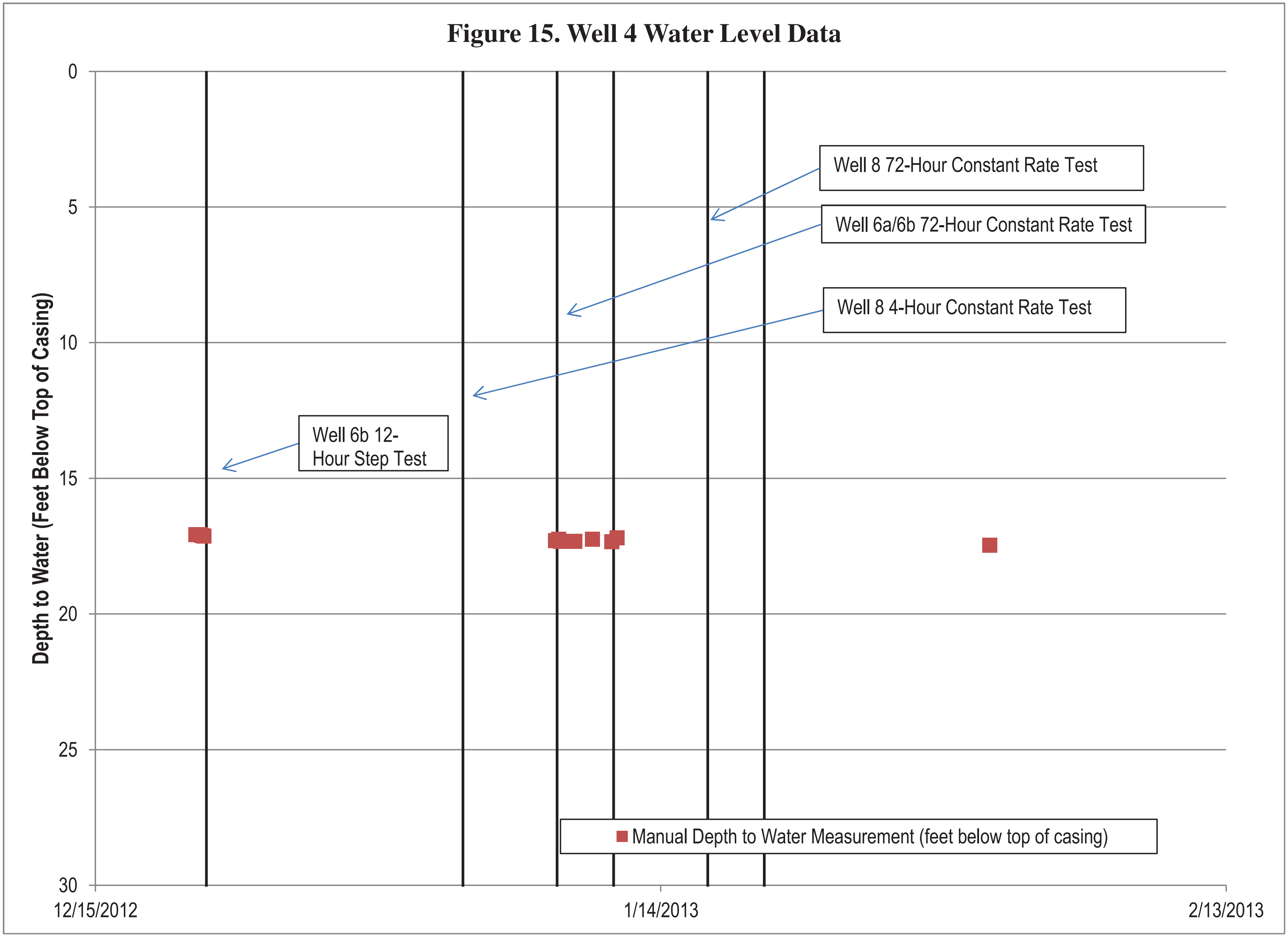
Figure 15. Well 4 Water Level Data
Depth to Water (Feet Below Top of Casing)
0
5
10
15
20
25
30
12/15/2012
1/14/2013
2/13/2013
Well 8 72-Hour Constant Rate Test
Well 6a/6b 72-Hour Constant Rate Test
Well 8 4-Hour Constant Rate Test
Well 6b 12-Hour Step Test
Manual Depth to Water Measurement (feet below top of casing)

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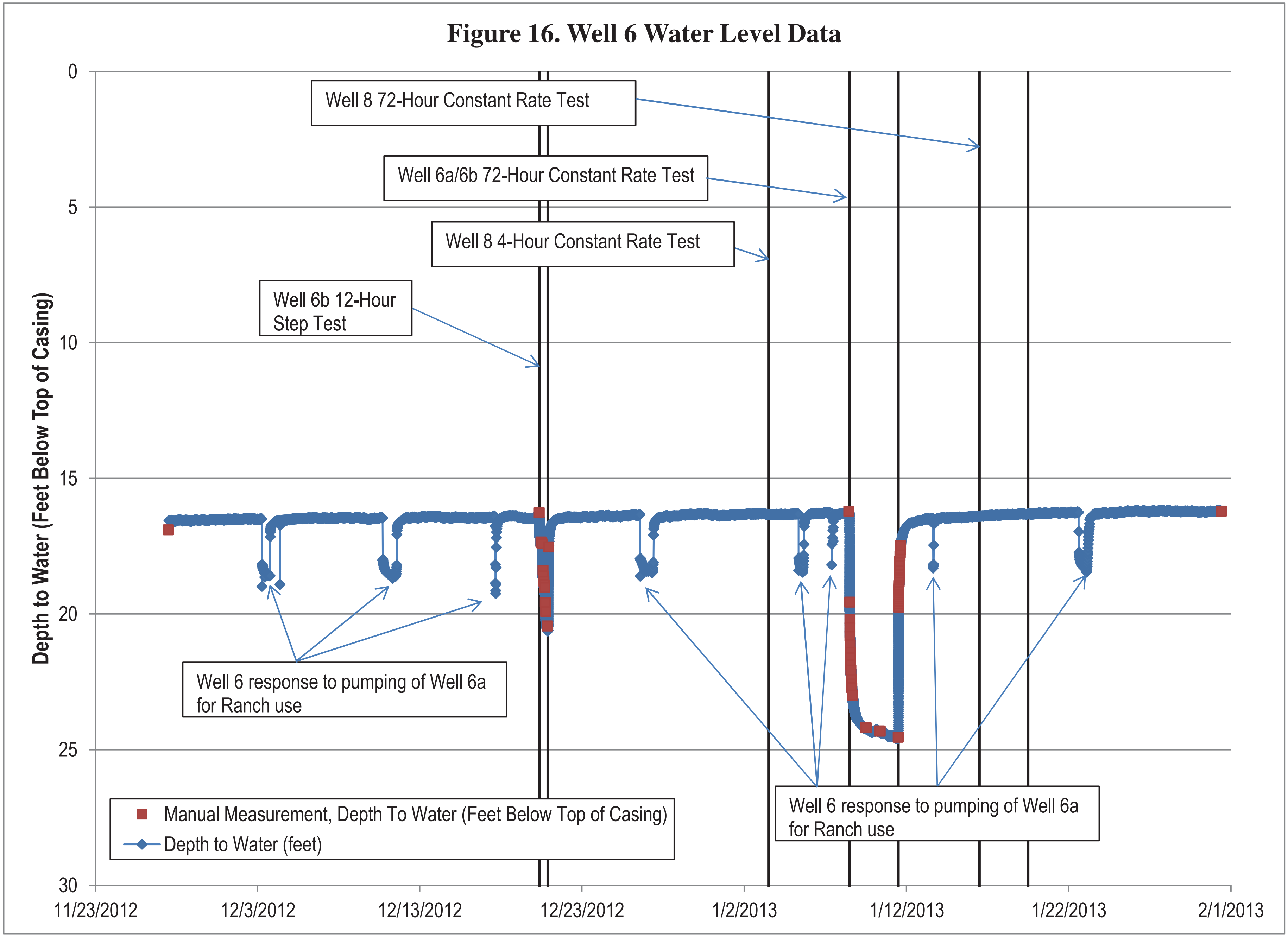
Figure 16. Well 6 Water Level Data
Well 8 72-Hour Constant Rate Test
Well 6a/6b 72-Hour Constant Rate Test
Well 8 4-Hour Constant Rate Test
Well 6b 12-Hour Step Test
Well 6 response to pumping of Well 6a for Ranch use
Well 6 response to pumping of Well 6a for Ranch use
Manual Measurement, Depth To Water (Feet Below Top of Casing)
Depth to Water (feet)
Depth to Water (Feet Below Top of Casing)
0
5
10
15
20
25
30
11/23/2012
12/3/2012
12/13/2012
12/23/2012
1/2/2013
1/12/2013
1/22/2013
2/1/2013

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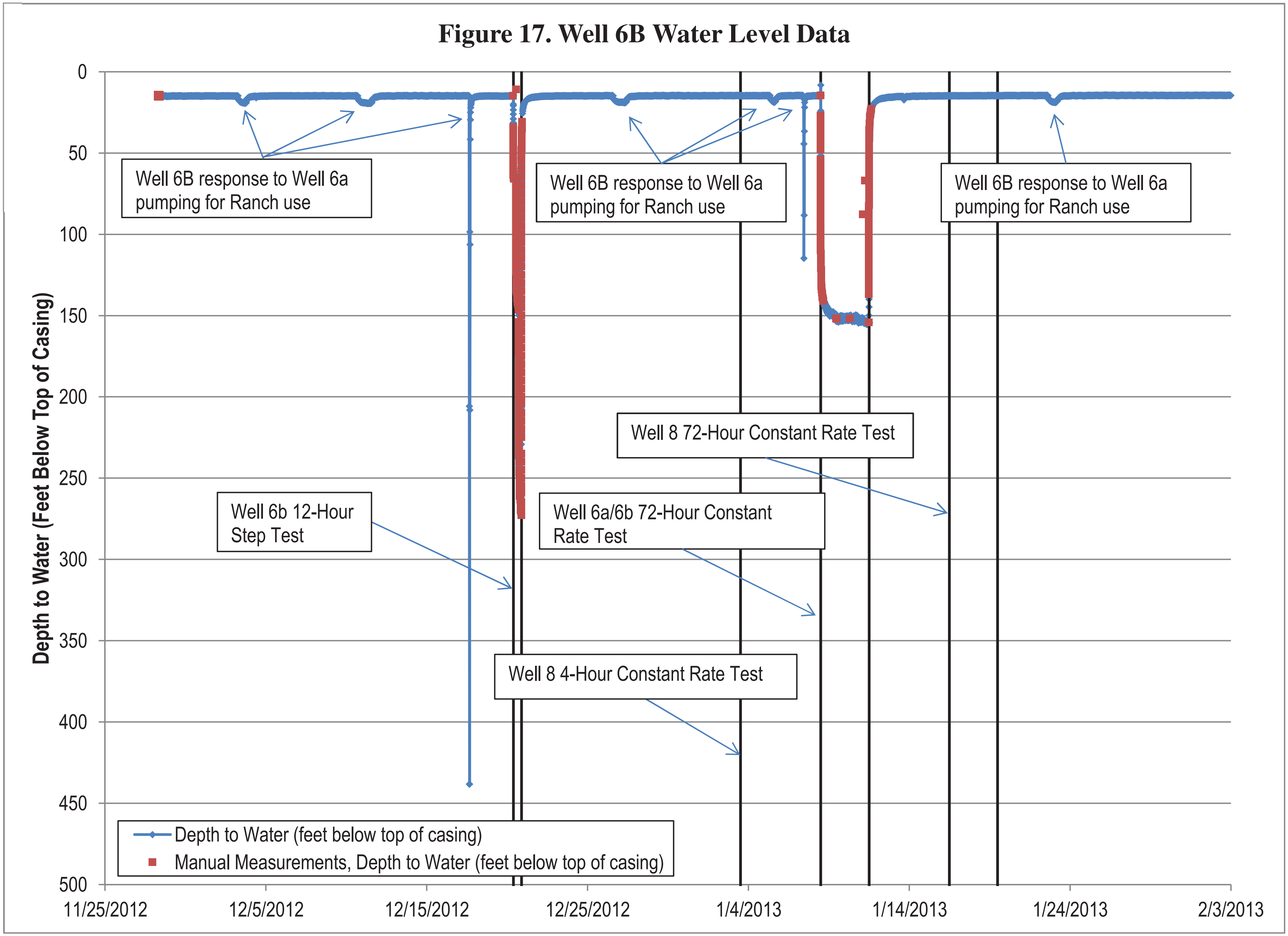
Figure 17. Well 6B Water Level Data
Depth to Water (Feet Below Top of Casing)
0
50
100
150
200
250
300
350
400
450
500
11/25/2012
12/5/2012
12/15/2012
12/25/2012
1/4/2013
1/14/2013
1/24/2013
2/3/2013
Well 6B response to Well 6a pumping for Ranch use
Well 6B response to Well 6a pumping for Ranch use
Well 6B response to Well 6a pumping for Ranch use
Well 8 72-Hour Constant Rate Test
Well 6b 12-Hour Step Test
Well 6a/6b 72-Hour Constant Rate Test
Well 8 4-Hour Constant Rate Test
Depth to Water (feet below top of casing)
Manual Measurements, Depth to Water (feet below top of casing)

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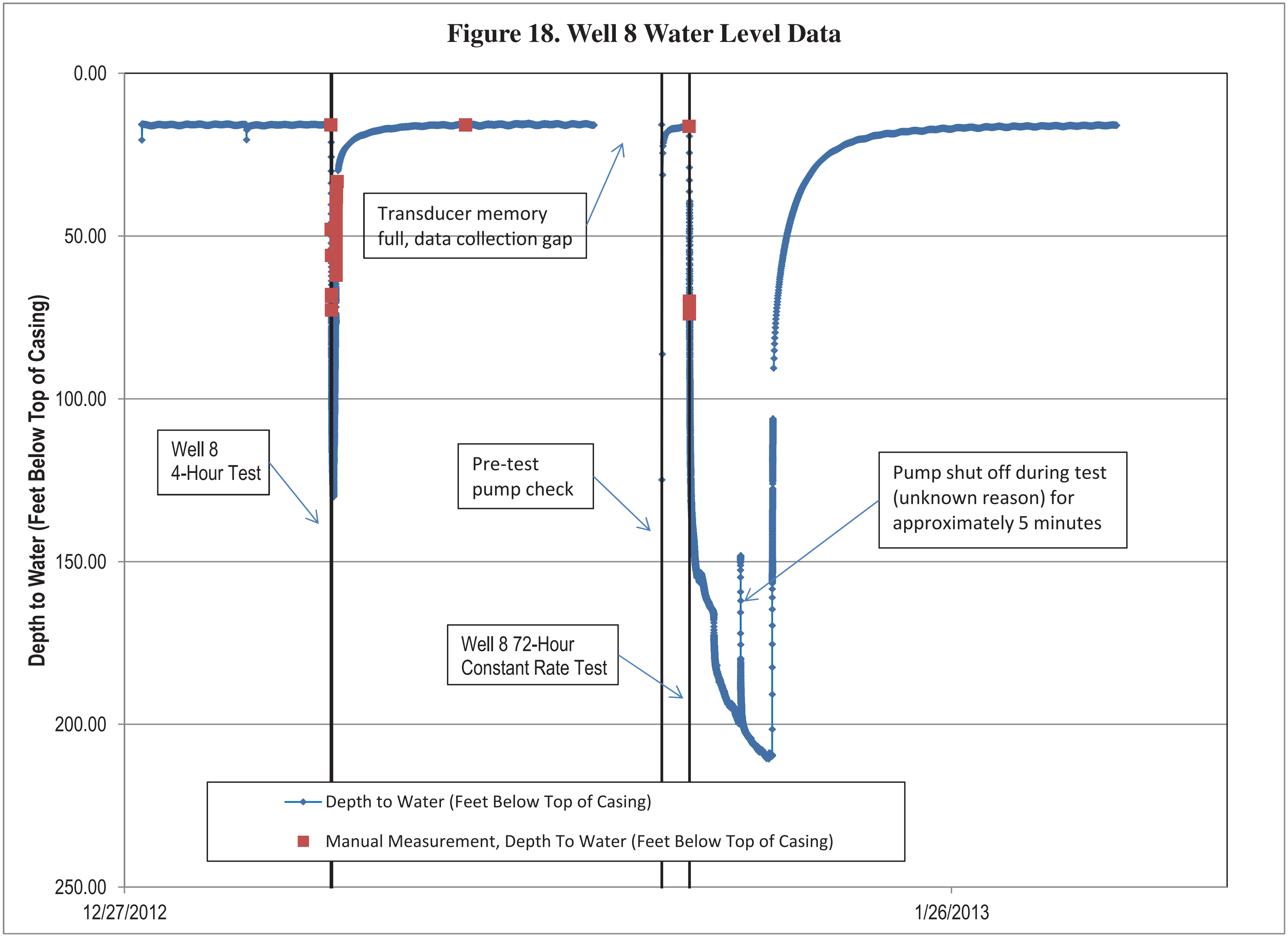
Figure 18. Well 8 Water Level Data
0.00
50.00
100.00
150.00
200.00
250.00
Depth to Water (Feet Below Top of Casing)
12/27/2012
1/26/2013
Transducer memory full, data collection gap
Well 8 4-Hour Test
Pre-test pump check
Pump shut off during test (unknown reason) for approximately 5 minutes
Well 8 72-Hour Constant Rate Test
Depth to Water (Feet Below Top of Casing)
Manual Measurement, Depth To Water (Feet Below Top of Casing)

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