DOCKETED

Docket Number:	02-AFC-01C
Project Title:	Sonoran Energy Project (formerly Blythe Energy Project Phase II) - Compliance
TN #:	210875
Document Title:	Project Owner's Follow-up to Preliminary Staff Assessment Workshop
Description:	Project Owner's Follow-up to PSA Workshop
Filer:	Judith Warmuth
Organization:	Stoel Rives LLP
Submitter Role:	Applicant
Submission Date:	3/28/2016 3:48:07 PM
Docketed Date:	3/28/2016

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March 28, 2016

VIA ELECTRONIC FILING

Ms. Mary Dyas, Compliance Project Manager
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814

Re: Sonoran Energy Project, Petition to Amend (02-AFC-1C)
Follow-up to Preliminary Staff Assessment Workshop

Dear Ms. Dyas:

On February 24, 2016, the California Energy Commission ("Commission") Staff held a public Workshop to discuss Staff's Preliminary Staff Assessment ("PSA") for the Sonoran Energy Project ("SEP" or the "Project"). As noted during the Workshop and in Project Owner's March 1, 2016 PSA comment letter, Project Owner herein provides additional information related to certain items discussed and questions raised by Staff during the February 24, 2016 Workshop.

I. SOIL & WATER RESOURCES

It is undisputed that the Project is licensed to use up to 2,800 acre-feet per year ("AFY") of water from the Palo Verde Mesa groundwater basin. Staff concurs that this is the baseline against which the PTA must be evaluated. [1] The PTA does not propose to change the quantity or source of water used for the Project and, therefore, there is no modification proposed that may have impacts on the environment or on the Project's ability to comply with LORS. (20 Cal. Code Regs., § 1769(a)(1).) Because SEP does not propose any changes to water use, such water use was previously found by the Commission not to result in potentially significant impacts on water supply, and the Project Owner is not proposing any changes to the previously approved water use, there is no legal basis for evaluating mitigation for or alternatives to the currently approved quantity or source of water used by the Project. (*See* 20 Cal. Code Regs., § 1741(b)(1); *see also* CEQA Guidelines, § 15126.6.)

[1] At the PSA Workshop on February 24, 2016, Staff agreed that the baseline for environmental review is 2,800 AFY.

A. Groundwater Levels Have Been Steadily Rising In the SEP Site Vicinity

Notwithstanding the foregoing, and as discussed during the Workshop, evidence exists in the record supporting the statement made by Project Owner's expert Tom Calabrese that groundwater levels in the site vicinity have been rising since the mid-1980s. First, and as indicated in footnote 30 of Project Owner's PSA Comments (see TN# 210578 at p. 15), there was a transposition error in the Groundwater Availability Report included as Attachment A of TN# 210068. Attached hereto as Attachment A is a revised Groundwater Availability Report prepared by EnviroLogic Resources, Inc., dated March 16, 2016. This Report replaces and supersedes the earlier Report included in TN# 210068. Note that corrections to the report were only made to the calculation of irrigation return flows under recharge, resulting in a change to Table 2 and corresponding text in the body of the Report.

Data that demonstrate the change in water levels since the 1980s are shown on the hydrograph for US Geological Survey monitoring well 006S022E09P001S.[2] This well has a record that extends from 1969 to present. The lowest recorded water level elevation in the well was in 1984, when groundwater was measured to be at an elevation of 242 feet above datum (NGVD, 1929). Since that time, water levels have been rising and the most recent data show groundwater to be at an elevation of about 254 feet. Water levels have risen 12 feet in the well since the mid-1980s, and have risen approximately 2 feet since the Blythe I facility commenced operation in 2003. This well is located approximately 3 miles north of the SEP site. A hydrograph prepared from the well data is presented in Appendix A of the Groundwater Availability Report provided herewith as Attachment A (this same hydrograph was also included in TN# 210068). Numerous other hydrographs are also presented in Appendix A to the Groundwater Availability Report, although none with a data set as continuous. Even so, most wells show a trend of increasing water levels in the Palo Verde Mesa groundwater basin.

During the Workshop, Staff asserted that groundwater beneath the Mesa is in an unsustainable condition. Unsustainable conditions are generally considered to be those where a depletion is occurring. The rising water levels on the Mesa are evidence that it is not in an unsustainable condition, despite pumping at BEP I for 13 years. In addition, the Mesa cannot be considered its own "bathtub." As with most groundwater basins, hydraulic connections to surrounding basins are natural conditions within which groundwater flows.

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[2] A figure showing the location of the well is attached hereto as Attachment B.

Staff suggested during the workshop that the approach used by the Project Owner's consultants to evaluate groundwater flow presented in the Groundwater Availability Report was a "new" way of looking at groundwater in the area. In fact, the equations governing groundwater flow are not new and in particular, Darcy's Law, which was used to evaluate groundwater flow beneath the SEP site, is one of the oldest and time-tested equations. (Darcy, H. (1856), Les Fontaines Publiques de la Ville de Dijon, Dalmont, Paris.) This equation forms the basis of many of the subsequent analyses that have been conducted by others related to groundwater flow in the Palo Verde Valley and Mesa. Rather than being new, it is a very old way of looking at groundwater flow that was derived by experimentation. (Darcy, H. (1856), Les Fontaines Publiques de la Ville de Dijon, Dalmont, Paris.)

B. The 2005 Commission Decision Determined that SEP's Water Use Conforms to Applicable Law and Policy

As noted in Project Owner's PSA comments (TN# 210578), the issue of connectivity between groundwater pumping in the Palo Verde Mesa groundwater basin and the Colorado River was addressed <u>in detail</u> in the 2005 Decision. In the 2005 Decision, the Commission determined that Palo Verde Mesa groundwater and the Colorado River are legally distinct, and project groundwater pumping would not cause a significant project or cumulative impact.

> In the context of PVID's volume of return water back to the Colorado River, the amount of recharge water (0.6%) is not significant. With the measurement methods employed in the River, the recharge water volume is not only insignificant, it is undetectable by measurement, even though it is actually happening according to the physical laws of hydrologic recharge.
>
> The Commission is extremely mindful of the potential impact of power plants on California's water resources. Our 2003 IEPR emphasizes the need for conservation and intelligent use of available water resources. Just as we laud combined cycle generating technology for its ability to recover and efficiently use waste heat, the Commission sees that in this case the groundwater has been recovered from water previously used for irrigation. With virtual certainty, the water that will recharge the aquifer in response to project pumping will be water dedicated initially to agricultural use. We are aware that some of the recharge water will be operational spillage; but this PVID water is effectively being used twice. Initially, it is dedicated to agricultural use, a significant segment of California's economy. Then it is recovered and stored in an aquifer as degraded

> groundwater to be used again for electricity production, also a significant and necessary segment of California's economy and welfare.
>
> Therefore, the proposed use of groundwater for project cooling does not violate any applicable federal law or policy and conforms to applicable California laws and water policy.

(*See* 2005 Final Decision at p. 254-55 (TN# 36138); *see also* Project Owner's PSA Comments, TN# 210578, at Parts I.A.5, I.D.) No further discussion of this topic occurred during the 2012 processing of the previous amendment of the existing license, other than a reduction in water use from 3,300 AFY to 2,800 AFY based on the change in technology proposed in that amendment.

C. The Water Conservation Offset Program is Voluntary

The Final Decision makes clear that the Project has no potential to impact water supply and, therefore, no mitigation is required. Notwithstanding the lack of impact, the prior project owner voluntarily proposed a water conservation program to offset project water use. The existing conditions of certification regarding the water conservation program are included to ensure the program is effective and does not cause unintended environmental impacts, but the program is not required to mitigate the Project's water use.

> The Applicant's WCOP is voluntary, since there are no applicable laws that require it and there are no CEQA environmental impacts which need to be mitigated through a WCOP. However, since the Applicant has proposed it as part of its project, the Commission has an interest in assuring that it is effective and not just window-dressing on the project. Plus, the Commission is responsible through CEQA to assure that the WCOP does not, itself, create adverse environmental impacts.

(2005 Final Decision at p. 272 (TN# 36138).) The same is true today. The water conservation offset program is not required to mitigate any impacts of the Project and consideration of any conservation program should only concern whether the program is effective and designed to minimize unintended environmental impacts.

1. Canal Lining is an Appropriate Conservation Measure

On February 23, 2016, the Project Owner filed a Technical Memorandum (TN# 210520) describing a voluntary canal lining program to reduce water conveyance losses in the PVID system in an amount equal to the Project's currently licensed water use of 2,800 AFY. Under the program, the Project Owner would line nine segments of the PVID canal system totaling 25,110 feet (4.76 miles) for a total water use efficiency improvement of 2,813 AFY. The cost estimate of the canal lining program is approximately $6.2 million, based on the conceptual design (a Class 4 cost estimate). In addition to the above, Project Owner also proposed providing PVID with a Caterpillar long-reach excavator that would allow for additional drain cleaning, which would further reduce water losses and further enhance PVID's water use efficiency.

During the Workshop, Staff posed various questions regarding the proposed canal lining program. Staff specifically questioned the calculations used in the Technical Memorandum, and stated that the methods used to determine surface area and gradient were incorrect. In fact, the methods described are appropriate to determine the inputs needed for the SLIDE v7.0 finite element model. For example, surface area is appropriately calculated using the wetted perimeter – seepage will occur wherever water is in contact with the unlined canal surface. Variations in seepage rates from the bottom of the canal to the edge of the wetted perimeter are factored into the SLIDE v7 model. Also, the appropriate model input for the gradient assumption is the distance from the midpoint of the wetted canal area to the static groundwater level. For these reasons, the Project Owner disagrees with Staff's statement that the methods used are incorrect.

Staff expressed a particular concern with the extent to which (if any) water would be conserved by canal lining. This is surprising, because Staff has supported canal lining to offset water use in other licensing proceedings (for example, the Mariposa Energy Project).[3] Although in this case canal lining would not provide the same direct consumptive use offset as fallowing, it is widely recognized as an important component of good agricultural water management. For example, seepage reduction is explicitly mentioned in California Water Code Section 10608.48(c)(5)[4]:

> Lining or piping the distribution system could increase distribution system flexibility and capacity, and decrease maintenance and seepage. Seepage and evaporation losses in earthen canals can be minimized by replacement with

[3] Mariposa Energy Project, Commission Decision (09-AFC-3), May 23, 2011, p. Soil & Water 8; *see also* CEC Staff's Response to Robert Sarvey's Comments [on Staff's Analysis of Petition to Amend Mariposa Energy Project] (TN# 205318), dated July 10, 2015.

[4] This section falls under the Part heading "Sustainable Water Use and Demand Reduction," Chapter 4 "Agricultural Water Suppliers."

> pipelines or lining with bentonite clay, pour-in-place concrete, or plastics/textile membranes.

This section is one of several new requirements for agricultural water management planning based on SB X7-7 (Water Conservation Act of 2009), the associated Agricultural Water Management Planning Act, the Agricultural Water Measurement Regulation, and Executive Order B-29-15. Consistent with these requirements, canal lining increases distribution flexibility and capacity, and, as previously stated, allows water to remain in the Colorado River. The Project Owner understands that surface water lost by seepage from unlined canals in the Palo Verde Valley is likely to return to the Colorado River; however, the quality of the groundwater discharging to the river is poor. Canal lining would decrease the driving head from seepage, and, therefore, groundwater would discharge to the Colorado River at a slower rate and water quality in the river would improve.

2. Water Conservation Through Fallowing Remains An Option

Notwithstanding the above information, Project Owner remains open to fallowing as contemplated by the existing Conditions of Certification and is currently discussing these, and other, conservation options with various water districts. Project Owner will provide Staff with additional details as they become available and remains confident in its ability to define a conservation program that is amenable to Staff. In exploring such options, it will be necessary to reconsider typical irrigation water use as the 4.2 acre-feet per acre calculation employed by Staff in 2005 no longer appears to have a valid basis. As set forth in data response 44 (TN# 206606), the 2013 PVID/MWD Forbearance and Fallowing Program Fallowed Land Verification Report estimated actual irrigation water use at 5.04 acre-feet per acre. Subsequent to filing data response 44, Project Owner obtained the 2014 version of the Land Verification Report (*see* Attachment C hereto), which estimates actual irrigation water use at 5.13 acre-feet/acre. The Land Verification Report states that the "actual use" method is the most reflective of the agronomic, weather, and market conditions prevailing in the Palo Verde Valley during calendar year 2014.

II. TRAFFIC & TRANSPORTATION

As discussed during the Workshop, the existing version of TRANS-9 in the project license is not feasible. Project Owner provided detailed comments regarding the infeasibility of the measures set forth in TRANS-9, as well as evidence demonstrating that such measures are unnecessary to mitigate any potential impacts of the SEP on aviation safety. (TN# 210578.) Project Owner's comments and previous filings demonstrate that SEP will not cause a significant impact to aviation safety that requires mitigation. As discussed during the Workshop, however, Project Owner looks forward to a future Issues Resolution Workshop/meeting involving Staff and representatives of the Federal Aviation Administration, Blythe Airport, and the Riverside County Airport Land Use Commission to discuss feasible alternative measures that are consistent with the operation of SEP.

In addition to the foregoing, at the Workshop CEC Staff referenced military use at the airport and stated that they were looking into the frequency of such use. According to AirNav.com, for the 12-month period ending February 28, 2015, the Blythe Airport was averaging 69 aircraft operations per day, as follows:

Aircraft based on the field: 7	Aircraft operations: avg 69/day *
Single engine airplanes: 5	50% transient general aviation
Multi engine airplanes: 2	50% local general aviation
	<1% military
	* for 12-month period ending 28 February 2015

The extremely limited military use of the Blythe Airport does not alter the Project Owner's conclusion that the SEP does not significantly impact aviation safety.

III. BIOLOGICAL RESOURCES

As discussed at the February 24, 2016 PSA Workshop, Project Owner is no longer proposing to discharge process wastewater to the onsite evaporation ponds except in the cases of cooling system initial commissioning, maintenance, planned or forced outages or emergency, consistent with Condition BIO-12. Instead SEP wastewater will be directed to the Blythe Energy Project's two evaporation ponds, which are currently in use and have bird deterrents in place. (*See* TN# 210635 (docketed March 7, 2016).)

IV. CULTURAL RESOURCES

As discussed during the Workshop, Project Owner is amenable to removing specific references to relevant tribes from Condition of Certification CUL-9.

V. TRANSMISSION SYSTEM ENGINEERING

During the Workshop, TSE Staff inquired about certain items set forth on the one-line diagram.

Power Factor

Staff requested that Project Owner review the applicable power factor for the project. The SEP will be designed to maintain a power factor within the full range of 0.85 lagging to 0.95 leading, which is the CAISO's and industry's standard design for combined cycle plants. However, at the plant's point of interconnection to Western's system, SEP is expected to operate within a 0.95 lagging to 0.95 leading, which is Western's normal operating range requirement.

Rating of Disconnect Switches and Transformers

Staff also requested that Project Owner review the disconnect switches and transformer ratings to determine if they are sufficient sized. It should be noted that the one-line drawing (TN# 206606 Figure DR46-1) shows that the generator rated at 596.5 megawatts (MWs) while the heat and mass balance (TN# 205652 Figures 2-7A and 2-7B) show that at site conditions the highest gross electrical production for the generator is 548.477 MWs (at 0 °F). As such, the disconnect switches and transformer are sufficiently sized for the combustion turbine/steam turbine generator at site conditions. As the detailed design for the interconnection facilities has not been completed, additional design details will not be available, which is the case for all Commission-approved projects. The interconnection facilities will be designed and constructed in conformance with the then-applicable standards and codes including the National Electrical Code, National Electrical Safety code, American National Standards Institute, IEEE, and others to assure that they are properly sized for the application. Furthermore, Project Owner expects the Energy Commission to include a standard Condition of Certification requiring a Chief Building Official to verify that the engineering design and construction comply with then-applicable laws, ordinances, regulations, and standards.

Project Owner looks forward to further discussions with Staff and appropriate agencies regarding outstanding issues, particularly with respect to water use and aviation, in advance of the Staff's publication of the Final Staff Assessment as well as discussing the status of Staff's processing of the Petition with the Siting Committee during the March 30, 2016 Status Conference.

Very truly yours,

Melissa A. Foster

MAF:jmw

ATTACHMENT A

GROUNDWATER AVAILABILITY

Sonoran Energy Project
Riverside County
Blythe, California

March 16, 2016

Prepared for

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GROUNDWATER AVAILABILITY

Sonoran Energy Project
March 16, 2016

This report has been prepared by *EnviroLogic Resources, Inc*., of Signal Hill, California.

EnviroLogic Resources, Inc. Project No. 10395.001

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GROUNDWATER AVAILABILITY

Sonoran Energy Project
Riverside County
Blythe, California

EXECUTIVE SUMMARY

This report provides the analysis of groundwater availability in the vicinity of the Sonoran Energy Project (SEP or Project) site. The SEP was originally approved by the California Energy Commission in 2005 and received additional approval in 2012 for some project modifications. A maximum use of 2,800 acre-feet per year (ac-ft/yr) of groundwater was approved at that time.

The region is characterized by a warm, dry climate with an average of 3.6 inches of rainfall per year. Rainfall occurs during the winter months from Pacific storms and during the summer monsoon season. The remainder of the State of California is impacted less by the monsoon season and instead has been impacted more by severe drought conditions that are worse than those in the City of Blythe area, including the SEP site.

The SEP site overlies the Palo Verde Mesa Groundwater Basin (PVMGB) near Blythe, Riverside County, California. It is located adjacent to the Blythe Energy Project Phase 1 (BEP) where monitoring of groundwater use and conditions has been conducted since startup in 2003. The City of Blythe utilizes groundwater for municipal purposes. Nearby proposed solar power developments are also reportedly relying on groundwater, which was taken into account for the analysis provided in this report.

The SEP site sits on a mesa above the floodplain of the Colorado River in the Colorado Desert Geomorphic Province. The Palo Verde Mesa Groundwater Basin is composed of sand and gravel deposits formed from the historic Colorado River channel and is east of the Palo Verde Valley Groundwater Basin and west of the Chuckwalla Groundwater Basin. These basins are in hydraulic connection as no low permeability boundary is present between them, other than those portions near mountain ranges.

Two broad geologic units are present in the area – consolidated bedrock and unconsolidated alluvium. Groundwater exists in the bedrock, filling deeper fractures. The alluvial units yield appreciable quantities of groundwater to wells and are estimated between 700 and 1,200 feet thick. The unconsolidated deposits are divided into four units from shallowest to deepest: 1) younger alluvium; 2) older alluvium; 3) Bouse Formation; and 4) fanglomerate.

The focus of this study is on the younger and older alluvium because while the deeper units can contain water, the shallower units generally provide sufficient water supplies to meet demands.

The groundwater balance for the upper Palo Verde Mesa Groundwater Basin – the area upgradient of the SEP site – was evaluated by examining the potential sources of groundwater withdrawal or discharge and balancing those with the potential recharge. For a groundwater basin that exhibits no change in storage, the balance of withdrawals/discharge and recharge will be zero.

The water levels in the upper Palo Verde Mesa Groundwater Basin have been rising, indicating an increasing amount of water is in storage. Hydrographs for onsite monitoring wells, as well as local wells in the State of California monitoring network show this trend. The amount of water that has been added to storage in the Palo Verde Mesa Groundwater Basin is significant and may amount to a 50-year supply at the 2,800 acre-feet/year use rate.

Groundwater availability was evaluated by defining the amount of groundwater flowing beneath the SEP site that is available to wells on the basis of a two-mile radius of influence that had been previously calculated by other licensed professionals. Site-specific data and information were considered in making this evaluation using Darcy's Law. Variables, such as hydraulic conductivity, hydraulic gradient, aquifer thickness, and the radius of influence were analyzed and a range of site-specific values was generated. Using these data in accordance with accepted customs and methodologies for calculating water availability, the amount of groundwater flowing beneath the SEP site is approximately 11,800 to 13,500 acre-feet/year.

Based on the amount of groundwater supplies described above, and given existing and anticipated demands, including SEP, sufficient groundwater is available to support the SEP at the 2,800 acre-feet/year use rate previously approved by the California Energy Commission.

1.0 INTRODUCTION

EnviroLogic Resources, Inc., was retained by Stoel Rives, LLP, to evaluate groundwater availability in the vicinity of the proposed Sonoran Energy Project (SEP) site. The project site is located in Riverside County, west of the incorporated City of Blythe, California as shown on Figure 1 (Project site).

The California Energy Commission (CEC) approved the Sonoran Energy Project (at that time called the Blythe Energy Project – Phase II) in 2005 with conditions (CEC, 2005). Since initial approval some project modifications were approved by the CEC in April 2012 and subsequent project modifications were submitted to the CEC in August 2015. The SEP is located adjacent to the Blythe Energy Project Phase I (BEP). BEP was completed in 2003 and has been operational since that time.

The State of California enacted into law effective January 1, 2015, the Sustainable Groundwater Management Act (SGMA). The focus of SGMA is the sustainable management of California groundwater basins (DWR, 2015a). California Department of Water Resources (DWR) is a primary-managing state agency for implementation of SGMA, with the State Water Resources Control Board (SWRCB) authorized under SGMA to protect groundwater basins where local public agencies do not do so. SGMA is mandatory for medium- and high-priority basins, but is voluntary for local agencies and private stakeholders located within basins characterized by DWR as low priority (DWR, 2015a). Based on information available from the SGMA web-based mapper, the groundwater basin in which the Project site is located - Palo Verde Mesa, as well as those basins in the immediately adjacent vicinity (Chuckwalla and Palo Verde Valley) - are identified by DWR as low priority basins under SGMA (DWR, 2015a). Accordingly, SGMA is not mandatory for the Project site and adjacent groundwater basins.

Use of groundwater in the Palo Verde Mesa Groundwater Basin is also subject to the proposed Lower Colorado River Accounting System (LCRAS) and the Accounting Surface, administered by the United States Bureau of Reclamation (Reclamation, 2015; USGS, 2009). The Accounting Surface extends to the margins of the Colorado River Aquifer which includes the Palo Verde Mesa Groundwater Basin (Reclamation, 2015). A proposed rulemaking by the Department of the Interior stated that wells with a static water level equal to or below the Accounting Surface are presumed to yield water that will be replaced by water from the Colorado River and therefore are subject to accounting and require an entitlement to use or divert river water (Department of the Interior, 2008). Wells that have a static water level elevation above the accounting surface are presumed to yield water that will be replaced by water from precipitation and inflow from tributary valleys (USGS, 2009). In 2009 the USGS updated the accounting surface and the elevation of the accounting surface in the project vicinity is between elevation 246 and 248 feet (USGS, 2009). The static water level at the Project site was documented as being above the accounting surface in 2003 as are current water levels (GeoTrans, 2003; AMEC, 2015).

The objective of this study is to evaluate groundwater characteristics, conditions, and availability for the permitted SEP and to determine groundwater availability for the Project site. In 2005, the CEC approved utilization of 3,300 acre-feet per year (ac-ft/yr) of groundwater for the project. In April 2012, in approving a technology change for the project, the CEC revised the project's license to allow a maximum use of 2,800 ac-ft/yr of groundwater for the project. With focus on groundwater availability for sustainable management and Staff's consideration of the Petition filed in August 2015, a site-specific evaluation including analysis of more recent data is appropriate to assess groundwater availability at the Project site.

2.0 PROJECT LOCATION

The Project site lies on the Palo Verde Mesa in Riverside County in southeastern California. DWR identifies the Project site as being located on the eastern side of Palo Verde Mesa Groundwater Basin (PVMGB) near the boundary with the adjoining Palo Verde Valley Groundwater Basin (PVVGB) (DWR, 2003). Both basins are interpreted to be hydraulically connected to each other and to the Colorado River (USGS, 2008). The Chuckwalla Groundwater Basin is located to the west of the Project site and DWR identifies that groundwater within the PVMGB is partially recharged by underflow from the Chuckwalla Basin (DWR, 2003). The location of the Project site with respect to the DWR groundwater basin boundaries is shown on Figure 2.

The Project site is located west of Blythe, but within the Blythe city limits. The City of Blythe utilizes groundwater as the water supply for municipal and domestic purposes. Agricultural development dominates Palo Verde Valley while less development has occurred on Palo Verde Mesa (Mesa). The Palo Verde Irrigation District (PVID) is a major stakeholder in the use of water for these agricultural activities. The PVID diverts Colorado River water through the valley in a series of canals. The majority of the Mesa and the adjoining mountains are primarily undeveloped.

2.1 NEARBY SOLAR DEVELOPMENTS

The Mesa area has been designated by the US Bureau of Land Management (BLM) as a Solar Energy Zone (BLM, 2015). The Project site is located east of the BLM Riverside East Solar Energy Zone (SEZ) and the BLM administers a significant amount of land in this area of Riverside County (BLM, 2015).

The BLM defines a SEZ as an area well suited for utility-scale production of solar energy, where the BLM will prioritize solar energy and associated transmission infrastructure development. BLM has designated 19 SEZs in the west/southwest United States. Three of these SEZs are located in California. The Riverside East SEZ is the largest of these three SEZs. The location of the Project site near the SEZ is analyzed because solar plants use some water. As of April 1, 2015, there are four approved projects within the Riverside East SEZ and three pending projects (BLM, 2015). Of these SEZ-listed projects, two are in the vicinity of the Project site. A third project (not listed by the BLM as being part of the SEZ development), the Blythe Mesa Solar Power Project (CACA 053213), is also in the vicinity of the Project site. These projects might seek to use groundwater as a source for some or all of their water needs. These three projects have not yet been constructed, however the three solar projects collectively are anticipated to use approximately 630 ac-ft/yr. As presented later in this report, if these projects are eventually constructed, adequate water supplies exist for the SEP and the proposed solar projects. Documents (environmental impact reports/appendices) for these projects have identified the following potential groundwater uses (BMSP, 2015; AECOM, 2010; AECOM, 2011).

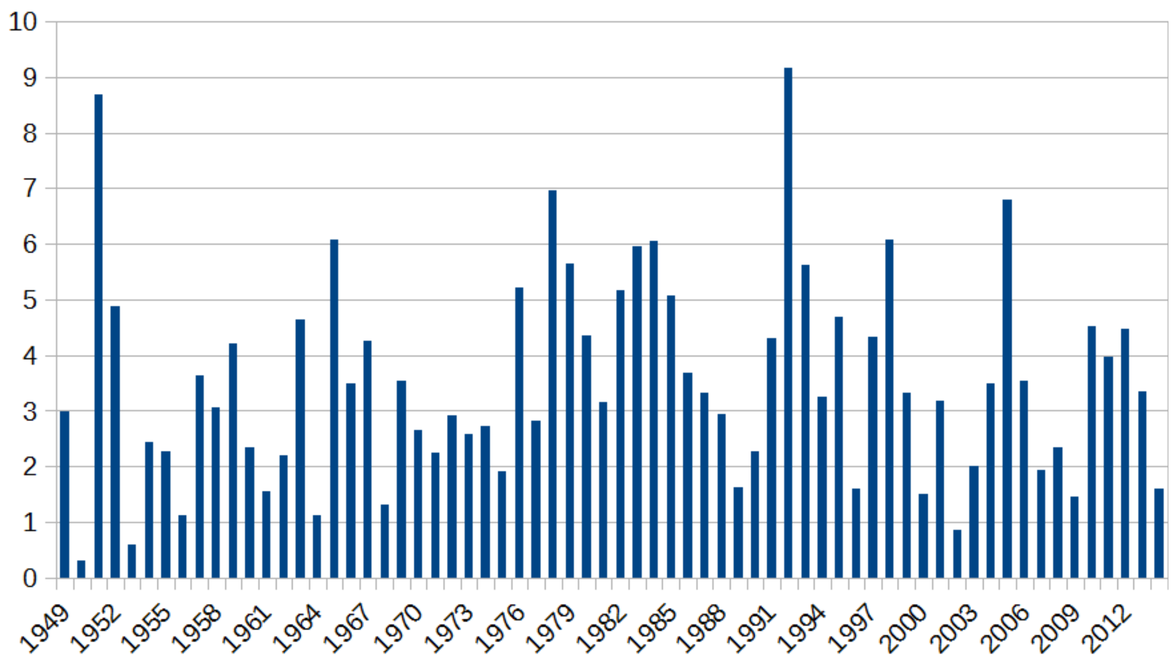
Project Name	Referenced Groundwater Use (ac-ft/yr)
Blythe Solar Power Project (09-AFC-6C)	600 ac-ft/yr[1]
Blythe Mesa Solar Power Project	< 1 ac-ft/yr
McCoy Solar Energy Project	30 ac-ft/yr

2.2 CLIMATE

The region has a dry, warm climate, characterized by mild winters and hot summers. The average temperature ranges from a low of 41°F in January and December to a high of 108°F in July. High temperatures, low humidity, and frequent winds lead to a high rate of evapotranspiration in the area (CEC, 2000). Precipitation is meager with an average annual rainfall at the Blythe Airport of 3.6 inches (California Climate Data Archive, 2015). Precipitation is typically concentrated about equally in two periods, one in the summer and one in the winter. During the winter months, the Pacific High weakens and migrates to the

1 Full build-out use as originally permitted; the Final Decision allows up to 40 ac-ft/yr for O&M

south allowing Pacific storms into California. In addition, the area receives some moisture during the summer monsoon season storms, which have high intensities and can result in rapid runoff (BEP, 2000). In the winter, storms from the Pacific Ocean cause gentle rains with little or no runoff. Occasionally, moist air from tropical disturbances can combine with monsoon moisture and cause heavy precipitation in the desert during August or September (Metzger, 1973). The annual precipitation in inches since 1949 (WRCC, 2015) is shown below:



While the majority of California has been subject to drought conditions over the last four years, precipitation in the Blythe area is nominally near normal over this time period as precipitation in the area is supplemented by monsoon moisture.

The major water body in the region is the Colorado River. No other perennial streams exist in the project area but numerous dry washes cross the Mesa, flowing generally southeast toward Palo Verde Valley. Studies in the Palo Verde Mesa and the nearby Bristol and Cadiz Playas (San Bernardino County) assumed that five percent of rainfall recharges groundwater (GSi/water, 2012; AECOM, 2010).

2.3 GEOMORPHIC LOCATION

The Project site lies within the PVMGB within the Colorado Desert Geomorphic Province (BMSP, 2015). This portion of the geomorphic province is characterized by broad alluvial valleys separated by steep discontinuous sub-parallel mountain ranges that generally trend northwest-southeast. The PVMGB is bounded by low permeability rock of the Big Maria Mountains to the northeast, Little Maria Mountains to the north, the McCoy and Mule Mountains on the west, and the Palo Verde Mountains and Valley on the south and southeast (Metzger, 1973). The Colorado River lies to the east and southeast, on the east side of the Palo Verde Valley. These geomorphic features are shown on Figure 2.

The elevation of the Project site is approximately 335 feet and there is minimal relief across the site (USGS, 1986). The Mesa generally has low relief until the vertical rise of the adjoining mountains or the steep drop to the adjoining Palo Verde Valley. The Mesa is approximately 80 to 130 feet above Palo Verde Valley (USGS, 1986). In this region the Mesa is roughly equivalent to the historic Colorado River flood plain and Palo Verde Valley is roughly equivalent to the recent floodplain of the Colorado River (AECOM, 2010). DWR Bulletin 118 indicates the surface area of the PVMGB basin is 226,000 acres and area of the PVVGB is 128,000 acres (DWR, 2003). The groundwater basin boundaries are shown on Figure 2.

From a surface water perspective, the geomorphic divides that define the PVMGB are represented by the mountain ridge lines and the basin divides between the mountain passes. Groundwater underflow may not mirror surface water flow and groundwater likely flows into the PVMGB from the adjoining Palo Verde Valley Groundwater Basin, Chuckwalla Groundwater Basin, and Rice Valley Groundwater Basin (Figures 3 and 5) (DWR, 2003).

The surface water drainage divides are shown on Figure 3 and include the pass between the Big Maria Mountains and the Little Maria Mountains; Upper Chuckwalla/Upper McCoy wash divide between the McCoy Mountains and the Little Maria Mountains; and Chuckwalla

Valley between the McCoy Mountains and the Mule Mountains. The surface water recharge area, or catchment, for the basin is larger in surface area than the groundwater basin itself.

3.0 HYDROGEOLOGY

The Project site is located on the Palo Verde Mesa, an alluvial-filled basin (Argonne, 2013). Regionally, this valley formed as a structural depression (pull-apart basin) and is composed of two broad geologic units, consolidated rock (bedrock) and unconsolidated alluvium (AECOM, 2010) The consolidated rocks consist of older age igneous and metamorphic rocks which form the mountains and the basement complex (Metzger, 1973). The consolidated rocks are of low permeability except for areas where fracturing or weathering has occurred. The total depth of the unconsolidated alluvium is unknown but the top of bedrock has been estimated from 700 feet to more than 1,200 feet below ground surface (Argonne, 2013). As shown on Figure 4 the mapped geology of the area shows numerous faults along and within the Big Maria Mountain range which may provide pathways for groundwater flow into the PVMGB (California Geological Survey, 2010). DWR has not identified restrictive barriers that would potentially inhibit groundwater flow in the PVMGB (DWR, 2003).

The unconsolidated alluvial aquifer is comprised of four units: Younger Alluvium (not present at the Project site), Older Alluvium, the Bouse Formation, and Fanglomerate (not mapped by Metzger (1973) as present beneath the Project site). The primary source of groundwater in the basin is found in the alluvial deposits that overlay the consolidated bedrock. Of these alluvial deposits the Colorado River gravel deposits in the Older Alluvium have the highest conductivity of any rocks in the region, and wells in the Mesa that penetrate the gravel zone are the most productive (Metzger, 1973). Beyond the gravel zone, sand is the dominant lithology. Within the Palo Verde Mesa, the Older Alluvium is over 500 feet thick and a water well log on the project property (PW-2) has identified the thickness of this portion of the aquifer to be at least 630 feet; with the terminus of the well log still within the gravel deposits. In the local area the maximum thickness of the alluvial sediments (Older Alluvium and Bouse Formation) is estimated from 700 feet to more than 1,200 ft in the region (Argonne, 2013). This alluvial aquifer is in hydraulic connection with the PVVGB and the Colorado River (USGS, 2008). The lithologies are described in the following sections.

3.1 YOUNGER ALLUVIUM

The younger alluvium consists of the historically active flood plain in the Palo Verde Valley area and is not located on the Mesa. The younger alluvium is composed of a basal gravel overlain by sand with silt and clay layers. The younger alluvium is generally thought to be between about 90 to 125 feet in thickness above its basal gravel, which can be between 5 and 20 feet thick (Metzger and others, 1973). Apart from the limited occurrence of the basal gravel, the contact between the older and younger alluvium is not distinguishable. Owens-Joyce (1984) indicated that the younger and older alluvium are hydraulically connected in the Palo Verde Valley. In the Palo Verde Hospital Well (6S/23E-32G2), the Colorado River fluvial deposits, inclusive of the younger and older alluvium, reportedly occurs to a depth of about 590 feet. The well log terminates in the Colorado alluvial deposits (Metzger, 1973).

3.2 OLDER ALLUVIUM

The older alluvium is generally comprised of a basal gravel above the Bouse Formation overlain by inter-layered sequences of sand and pebbly sand, with lenses of cobble gravels and silt and clay. Beneath the Project site this sequence has been measured as over 630 feet thick and was identified as an unconfined aquifer (GeoTrans, 2003). In the Blythe area, this sequence has been measured as much as 600 feet in thickness (Metzger, 1973). The older alluvium forms the mesa above the flood plain and is encountered below the younger alluvium on the flood plain. Municipal wells located on the flood plain within the City of Blythe boundaries, are generally completed between 100 and 350 feet in depth with a short (< 100 feet) perforated zone in the older alluvium. These wells generally produce between 250 and 750 gallons per minute (gpm) but can produce up to 2,500 gpm (Metzger 1973; DWR 1978). City of Blythe Wells (11, 18, and 19) produce between 1,000 and 1,500 gpm (City of Blythe, 2011).

3.3 BOUSE FORMATION

The upper Miocene to Pliocene age Bouse Formation underlies the alluvial deposits. Few wells produce from the formation except near the City of Blythe. The upper Bouse Formation ranges from 500 to 600 feet below land surface and consists of interbedded clay, silt, and sand. The upper Bouse Formation is considered an aquifer, while the lower Bouse Formation is considered an aquitard. Well yields can vary depending on the degree of formation consolidation and stratigraphic location of the perforations (Metzger, 1973).

3.4 FANGLOMERATE

The fanglomerate is considered a water-bearing deposit, though no wells are known to have been completed in it because of its relative depth to other water-bearing deposits. Estimated depth to the top of the fanglomerate can be greater than 800 feet below land surface but varies widely throughout the basin (Metzger, 1973).

3.5 BEDROCK

Igneous and metamorphic rocks, including metamorphosed sedimentary rocks make up the basement complex in the area. Metzger (1973) concluded that only small yields are likely to be developed, principally from fractures. Metzger did not identify faulting in the area and concluded that these units were an unimportant as a source of water (Metzger, 1973). More recent mapping of the area has identified faulting along and within the mountain ranges that indicate a potential for groundwater flow between basins (California Geological Survey, 2010).

4.0 GROUNDWATER AVAILABILITY

Two well-established and accepted methodologies were combined to evaluate groundwater availability for the proposed development at the Project site. The first methodology evaluated the availability based on calculating the amount of groundwater flowing beneath the Project site. This groundwater would be available for extraction by one or more wells for use on the overlying lands. This evaluation was done using Darcy's Law, which describes flow through porous media. The second methodology quantified the groundwater resource by developing an annual water balance analysis for this portion of PVMGB. The results of the Darcy's Law evaluation provides an input term to the basin water balance analysis. The area of the PVMGB catchment is shown on Figure 5.

4.1 VOLUME OF GROUNDWATER AVAILABLE TO THE PROJECT

This first method used to evaluate groundwater availability considers site-specific aquifer parameters to estimate the amount of groundwater flowing in the aquifer beneath the site that would be available to a potential future well. Work completed as part of the BEP development provides aquifer-specific information that can be utilized in the Darcy's Law evaluation. Aquifer testing has been conducted utilizing the two BEP production wells (PW-1 and PW-2) and groundwater levels have been monitored for over twelve years (AECOM, 2015; AMEC, 2012; GeoTrans, 2003). This evaluation has the advantage of relying on monitoring and test data that represents actual conditions at the site.

As noted in Section 3.2, the aquifer in this area is an unconfined alluvial aquifer. Darcy's Law can be used to describe groundwater flow through an aquifer with these characteristics. Although the underlying, less productive, Bouse Formation is also a viable aquifer, this evaluation was limited to the overlaying alluvial aquifer. This assumption allows for a conservative estimate of the volume of groundwater flowing beneath the project.

Darcy's Law can be expressed as:

$$Q=KiA$$

where,

Q = quantity of groundwater flow;
K = hydraulic conductivity;
i = hydraulic gradient; and
A = cross sectional area of flow.

Hydraulic Conductivity, K: Values for transmissivity, T, were reviewed from the aquifer tests that were conducted on the BEP site production wells (PW-1 and PW-2) as documented in the GeoTrans (2003) report[2]. *EnviroLogic Resources'* review identified that a conservative T value for the site is 69,600 ft^2/day (GeoTrans, 2003). A representative T value was developed by averaging five T values presented in the GeoTrans report (Table 3). These T values were developed using a couple of methods of evaluating the aquifer test data that are considered most applicable given the site conditions and well geometry. Because none of the monitoring wells or observation wells are screened or completed in the same zone as the production wells only values developed from data for the production wells were used. The average T value is 123,000 ft^2/day. This represents a realistic mid- range value for the site. The range of T values are summarized in Table 3 of the GeoTrans report (GeoTrans, 2003).

To calculate hydraulic conductivity, K, we use the equation, T= Kb, where b is the aquifer thickness. The derivation of aquifer thickness is described in detail below. For this analysis, an aquifer thickness of 555 feet was used to calculate K from the T values developed by GeoTrans (2003). This results in a range of K from 127 ft/d, based on the most conservative T, to 222 ft/d, for the average of the most reasonable values of T.

Hydraulic Gradient, *i*: Hydraulic gradient (i) values were calculated from the 5-year summary report for the BEP site as presented by AMEC (AMEC, 2012). The hydraulic gradient ranged from 0.0005 to 0.001 during the five year period from 2007 to 2011. The BEP site-specific hydraulic gradient values were consistent with regional values that *EnviroLogic Resources* calculated from groundwater flow contours presented in Metzger

2 An aquifer test is not time-dependent. The same results would be expected if the aquifer test were conducted today.

(1973), the Blythe Mesa Solar Project report (BMSP, 2015), the AECOM report (2011) for the McCoy Solar Project, and the AECOM (2010) report prepared for the Blythe Solar Power Project.

Cross-Sectional Area, A: The cross-sectional area of the aquifer (A) was determined based on utilizing the saturated aquifer thickness across the width of the aquifer that would be available to a future well.

Aquifer Width**:** As presented by GeoTrans (2003) a potential radius of influence of greater than 2 miles (over a 40-year period of operation) was calculated. This correlates to an aquifer width of over 4 miles. The aquifer width utilized for this calculation is 22,900 feet (approximately 4.3 miles). The McCoy Mountains act as a hydraulic constraint to the west and the break in slope between the mesa and valley represents the boundary to the east. The eastern boundary was identified on the basis of the regional direction of groundwater flow. The aquifer width is presented on Figure 6 and it coincides with the cross sectional area of groundwater that is naturally flowing out of McCoy Wash.

Aquifer Thickness: Well PW-2 was drilled to a depth of 630 feet and based on the driller's log the bottom of the well is still within the alluvial aquifer (a log is not available for PW-1). With a depth to water of 88 feet this results in a saturated aquifer thickness of 542 feet. Since the site well did not penetrate the full aquifer thickness further research was conducted to estimate an alluvial aquifer thickness in this area. As noted above the aquifer thickness is being limited to the alluvial aquifer. No well logs were identified that penetrated the full alluvial aquifer thickness in the immediate site vicinity. Based on information presented in Metzger a probable saturated alluvial aquifer thickness in this area is potentially as great as 635 feet. This is based on the Palo Verde Hospital Well 2 and the cross section Metzger developed. The hospital well was drilled to a depth of 590 feet and Metzger identified it is entirely within the alluvial aquifer. Projecting this elevation (-320 ft) to the Project site results in a saturated aquifer thickness of 567 feet. A cross section in the 1973 Metzger report identified the contact in the Project site area as near elevation -390 which equates to a saturated aquifer thickness of 637.

In order to make a reasonable yet conservative estimate of the aquifer thickness, the average between the saturated thickness in the site well (542 feet) and the Palo Verde Hospital Well (567 feet), or 555 feet was used as the saturated aquifer thickness in this evaluation. It is likely that the older alluvium aquifer extends to depths much deeper than 630 feet as proposed by Metzger (1973).

Not considering the underlying Bouse Formation as part of the aquifer thickness also results in a conservative estimate because groundwater is present in the Bouse Formation and it can be utilized as an aquifer.

Quantity of Groundwater Flow, Q: The calculated values for Q range from 32.3 acre-feet per day (ac-ft/d) to 36.9 ac-ft/d and are summarized in Table 1. The anticipated groundwater demand for the site development is 2,800 ac-ft/yr or 7.7 ac-ft/d. The yearly flow available to a future well ranges from 11,800 ac-ft/yr to 13,500 ac-ft/yr. On this basis, sufficient groundwater is available to supply the SEP development.

4.2 AVAILABILITY BASED ON GROUNDWATER BALANCE

DWR estimates that the groundwater storage capacity of PVMGB is approximately 6,840,000 acre-feet (DWR, 2003). The annual permitted Project use of 2,800 ac-ft/yr is less than 0.1 percent of the potential storage capacity (DWR, 2003). The volume of water flowing through PVMGB and PVVGB was estimated to be 426,600 ac-ft/yr as calculated from the water balance developed for the Blythe Solar Power Project and the McCoy Solar Project (AECOM, 2011 and AECOM, 2010). This flow is two orders of magnitude greater than the proposed SEP use.

The Project site lies at the mouth of McCoy Wash. Groundwater flow through areas that would not be accessible to wells at the Project site are not considered in this analysis. Specifically, water flowing past the Project site that is outside the two-mile radius of influence calculated for the wells (GeoTrans, 2003) is not considered part of the potential supply. McCoy Wash is a semi-enclosed basin; it is bounded by mountains and topographic drainage divides between the PVMGB and basins to the north and west. The topographic outflow is the southeastern end of McCoy Wash where water discharges to the lower PVMGB and the PVVGB. These features are shown on Figures 3 and 5.

In the site vicinity there have been several studies that present water analysis or balances to varying degrees of detail. Most of these studies looked at the entire PVMGB and the adjoining PVVGB as defined by DWR without consideration to project location. From a regional perspective this is appropriate since these two basins are hydraulically connected along their common boundary. Information from these existing water balances was reviewed and utilized where consistent with accepted methodologies, as appropriate. In particular, the Blythe Solar Power Project groundwater balance provided significant information (AMEC, 2011). A key point to many of the balances is that from a basin-wide perspective groundwater levels in the PVMGB have remained relatively stable or risen since the 1980s (AECOM, 2010; DWR, 2003; DWR, 2015; USGS, 2015). Perhaps more significant is that groundwater levels at the BEP facility have remained stable or risen since the facility started pumping groundwater in 2003. Data collected in 2015 confirms this continuing trend. These site-specific data confirm that groundwater withdrawals are not exceeding groundwater recharge. If withdrawal exceeded inflow then groundwater levels would be falling.

The following sections describe the groundwater balance for this portion of the PVMGB. The inflow and outflow are discussed in the order as presented in Table 2 which presents the groundwater balance.

INFLOW - Sources of Groundwater in the McCoy Wash area of PVMGB

The hydrologic cycle identifies three main ways groundwater enters a basin; either as infiltration and percolation from rainfall, infiltration and percolation from streams or runoff, and inflow from groundwater in adjoining basins. In the PVMGB there are no naturally occurring surface water bodies therefore direct infiltration is from precipitation (and irrigation) or from infiltration of runoff during larger storms. This runoff includes surface water that flows from the adjoining low permeability bedrock mountains. Recharge from groundwater inflow from the adjoining groundwater basins has been estimated by others (Owen-Joyce, 1984; AECOM, 2011; DWR, 2003).

Recharge from Infiltration**:** Recharge by percolation from infiltration is either from precipitation or agricultural activities. Precipitation is subject to three main processes; evapotranspiration, runoff, and infiltration. Typically in these types of arid climates, studies have identified that less than 10 percent of total rainfall recharges the groundwater. The remaining water is primarily lost to evapotranspiration. Using an average annual rainfall from Blythe Airport (3.6 inches), an infiltration rate of 5%, and a total catchment area of 165,000 acres, an annual recharge from rainfall infiltration and runoff was calculated at 2,500 ac-ft/yr. The catchment area includes the low permeability adjoining mountains. Rainfall there is less likely to infiltrate but will discharge as runoff to the basin and then infiltrate.

Recharge from agricultural activities was based on information developed by others (AECOM, 2011) and GIS information available through the Riverside County GIS website, the PVID website, and Google Earth imagery. Based on aerial imagery analysis, approximately 1,500 acres are actively irrigated on the mesa. Based on crop efficiency numbers presented by AECOM, return flow at a per acre recharge rate of 1.3 ac-ft/yr per acre of irrigated land was calculated. This value appears consistent with other studies we have reviewed in the past. For the McCoy Wash area this results in infiltration of agricultural return flows of 1,950 ac-ft/yr, or 2,000 ac-ft/yr considering significant figures.

Recharge from Groundwater Underflow**:** Recharge from groundwater inflow is less well understood in the PVMGB. Groundwater levels have been stable or rising over the last 30 years and as such there must be a balance between inflow and outflow, or inflow exceeds outflow. Inflow from the Chuckwalla Valley has been estimated from 400 ac-ft/yr to 1,000 ac-ft/yr; underflow from Parker Valley has been estimated from 3,000 ac-ft/yr to 3,500 ac-ft/yr (AECOM, 2011; Meztger, 1973; DWR, 1973); and underflow from upper McCoy Wash has been estimated at 175 ac-ft/yr (BMSP, 2015). The overall recharge from groundwater underflow was estimated at 19,100 ac-ft/yr. This value is driven by the calculated value from the Darcy's Law analysis (12,600 ac-ft/yr) on the discharge side of the equation.

The recharge from groundwater underflow is likely from the drainage divides at the upper end of McCoy Wash, Chuckwalla Valley, PVVGB, and from faults along the front and through the Big Maria Mountains. The geologic map identifies numerous faults along this mountain range that could allow inflow from the Rice Valley Groundwater Basin and Parker Valley.

OUTFLOW – Groundwater Uses in the McCoy Wash Area of PVMGB

In AECOM (2011) significant information on the uses of groundwater in the Mesa area of the basin were documented. These included the Blythe Airport Well, Mesa Ranch Well #3, the Palo Verde College Well and the Mesa Well #2 for the golf course. These total uses were estimated at 500 ac-ft/yr. To err on the side of under-quantifying the amount of groundwater supplies, we assume the current extent of agricultural use could range up to 7,500 ac-ft/yr, which is based on a value for agricultural use on the mesa (estimated at 5 ac-ft/ac per year) developed by AECOM (2011). An aerial photo analysis indicates about 1,500 acres is under irrigation on the Mesa.

BEP is licensed to utilize a maximum of 3,000 ac-ft/yr and SEP is licensed to use a maximum of 2,800 ac-ft/yr for a total of 5,800 ac-ft/yr. The current natural groundwater outflow as calculated using Darcy's Law is an average of 12,600 ac-ft/yr.

If 23,600 ac-ft/yr of groundwater is discharging naturally though groundwater underflow and pumping for beneficial uses, to be in balance the total inflow must be 23,600 ac-ft/yr. Inflow accounted for through infiltration of percolating waters and from the agricultural return flows was estimated at 4,500 ac-ft/yr. The remaining inflow required to balance the water supplies is 19,100 ac-ft/yr.

5.0 CONCLUSIONS

Groundwater availability was calculated on the basis of Darcy's Law using site-specific parameters. The result of the groundwater analysis is that groundwater supplies exist and are quantified as being 12,600 ac-ft/yr flowing beneath the Project site, or stated differently, the Project site is located on lands overlying the groundwater supplies for which 12,600 ac-ft/yr of groundwater exists. Our evaluation of other professional engineering and hydrogeological analyses, coupled with *EnviroLogic Resources*' analysis of this Project site using accepted methodologies, results in calculations and conclusions that represent a conservative quantification of groundwater supplies available to the Project site, and more generally, the local vicinity.

Similarly, the high confidence of the Darcy's Law value leads to a water balance analysis for the catchment upgradient of the property that is based on reasonably well-defined terms. The water balance analysis was developed on the basis of the assumption that the amount of groundwater in storage is constant. However, water levels have risen nearly 3-5 feet since 2007. As a result, approximately 135,000 acre-feet additional groundwater is now in storage, assuming 30 percent porosity of the aquifer materials in the PVMGB. The additional storage amounts to a 50-year supply of water at the 2,800 ac-ft/yr utilization rate at SEP. A hydrograph for the monitoring wells on-site showing the water level changes since 2007 is shown on Figure 7. Hydrographs from numerous wells monitored by the State of California and the USGS are presented in Appendix A. These hydrographs also generally show a rising water level trend.

The analysis completed shows sufficient quantities of water are available for operation of the SEP using the maximum licensed allocation of 2,800 ac-ft/yr.

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TABLES

TABLE 1
GROUNDWATER AVAILABILITY
Sonoran Energy Project
Blythe, California

Darcy's Law	Q=KiA	Q = Flow of water through a cross sectional area per a unit of time.
K = Hydrualic Conductivity	K= Transmissivity (T) divided by thickness. Aquifer thickness 550 feet.	
		T as presented in GeoTrans PW-1 aquifer test is 69,600 ft2/day (GeoTrans 2003, summary)
		Average T as an arithmetic mean of both PW-1 and PW-2 test results is 123,000 ft2/day (GeoTrans 2003, Table 3)
i=Hydraulic Gradient	From Amec 5-year site specific summary report .001 to .0005 (Amec, 2012)	
A= area of aquifer;	Aquifer width is 22,900 ft based on width of upper mesa perpendicular to gradient direction and hydraulic constraints. 555 feet was used as depth of saturated alluvial thickness. Depth of alluvial aquifer beneath the site is known to be at least 630 ft. Saturated thickness starts at 88 feet below ground surface (see below).	
		PW-2 well log is still in alluvium at a total depth of 630 ft (Elev. -295) for a saturated aquifer thickness of 542 feet.
		Palo Verde Hospital Well (Blythe) is in alluvium to total depth of 590' (Elev -320). Projecting this elevation results in a saturated aquifer thickness of 567 feet (from Metzger 1973). Average of this and PW-2 thickness was used as final depth.
		Metzger Cross Section (1973, Plate 1) shows contact at ~ Elev -390 ft near project site. This results in a saturated thickness of 637 feet.

	IN PUT RANGES		
K (ft/day)	127	222	
I	0.001	0.0005	
A (ft2)	12,700,000	12,700,000	
Q=ft3/day	1,606,550	1,407,160	
Q=AF/day	36.9	32.3	
Q-AF/Year	13,462	11,791	(Average flow is 12,600 afy)

Avg. Daily site use (Phase II) is 7.7 AF/day (2800 AFY)

Avg. Daily use Phase I (3000 AFY) and Phase II (2800 AFY) is 15.9 AF/day

1 acre foot (AF) =43,560 cubic feet

Note: Only data from PW-1 and PW-2 were utilized because none of the monitoring or observation wells are screened or completed within the same depth interval.

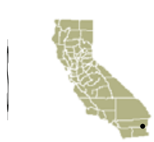
TABLE 2
CURRENT WATER BALANCE
Sonoran Energy Project
Blythe, California

RECHARGE AND DISCHARGE	Acre-feet per year (afy)	BASIS FOR ESTIMATE
Recharge (Inflow)		
Underflow from Adjoining Basins	19,100	Estimated on the basis that groundwater levels have stabilized or risen in at least the last 10 to 15 years and as such there must be a balance between inflow and outflow (or inflow exceeds outflow) (AMEC, 2012; DWR, 2003; DWR, 2015; USGS, 2015). Outflow was calculated as approximately 23,600 afy. Recharge from rainfall and agriculture was estimated at 4,500 afy. Therefore inflow to this portion of the basin is on the order of 19,100 afy. This is consistent with groundwater contours presented by various authors that all indicate the groundwater flow in McCoy Wash represents a source of groundwater recharge. Significant groundwater inflow appears to occur from adjoining basins and potentially along fractures from faults mapped within the Big Maria Mountains.
Infiltration		
Agricutural Return – Mesa	2,000	Based on imagery and PVID maps approximately 1500 acres are currently under irrigation within the McCoy Wash area of the mesa. The irrigation return flow is after AMEC 2011 (per acre return of 1.3 acre-feet per acre irrigated). For 1500 acres the return flow is 2.000 afy (1500 x 1.3=1,950 afy).
Mountain Front Runoff and Precipitation	2,500	Estimate derived using average rainfall of 3.6-inches (Blythe Airport). Infiltration rate of 5% for precipitation and runoff. Total catchment area estimated at 165,000 acres and includes permeable McCoy Wash and less permeable mountain front discharge. (3.6-inches equals 0.3 ft) (165,000 acres x 0.3 ft per year x 0.05 = 2,475 afy)
Total Inflow	23,600	
Discharge (outflow)		
Municipal and Domestic	500	After Aecom, 2011, for Blythe Solar: Mesa Ranch Well #3 for domestic use 230 afy, PVC Well 2 for municipal use at the Palo Verde College 260 afy, Mesa Well #2 for golf course 560 afy, Airport Well #7 at the Blythe Airport that serves the Mesa Verde Community 47 afy.
Blythe Energy Phase I	3,000	Groundwater use at Blythe Energy – Phase I, developed in 2003.
Agricultural -Mesa	7,500	After Aecom, 2011. Based on aerial photo review there was approximately 1500 acres that was being irrigated in this portion of the mesa. Discharge estimated at 5 ac-ft/ac per year.
Groundwater Discharge	12,600	Calculated underflow (Darcy's Law) of groundwater discharging from McCoy Wash.
Total Outflow	23,600	
WATER BALANCE	**0**	

FIGURES

1 inch = 10 miles

0 2 4 6 8 10 Miles



Explanation

Project Location

GCS WGS 1984
Datum of 1984
Prepared November 13, 2015

Sources: USGS Topo Map (basemap.nationalmap.gov WMS Service), BLM CadNSDI PLSS (GeoCommunicator LSIS, 2015)

This map was prepared for the purpose of identifying the location of general site features and water resources only and is not intended to provide a legal description or location of property ownership lines.

EnviroLogic Resources, Inc.
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FIGURE 1
SITE LOCATION

Sonoran Energy Project
Blythe, California

1 inch = 5 miles

0 1 2 3 4 5 Miles

Explanation

Project Location

Groundwater Basins

GCS WGS 1984
Datum of 1984
Prepared December 31, 2015

Sources: NAIP 2012 aerial imagery (map.dfg.ca.gov WMS Image Server), California Groundwater Basins 2015 (www.water.ca.gov shapefile)

This map was prepared for the purpose of identifying the location of general site features and water resources only and is not intended to provide a legal description or location of property ownership lines.

EnviroLogic Resources, Inc.
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FIGURE 2
GROUNDWATER BASINS

Sonoran Energy Project
Blythe, California

1 inch = 5 miles

0 1 2 3 4 5 Miles

Explanation

Project Location

Groundwater Elevation Contour

Groundwater Basins

GCS WGS 1984
Datum of 1984
Prepared December 31, 2015

Sources: NAIP 2012 aerial imagery (map.dfg.ca.gov WMS Image Server), California Groundwater Basins 2015 (www.water.ca.gov shapefile), Groundwater Elevations (AECOM, 2010)

This map was prepared for the purpose of identifying the location of general site features and water resources only and is not intended to provide a legal description or location of property ownership lines.

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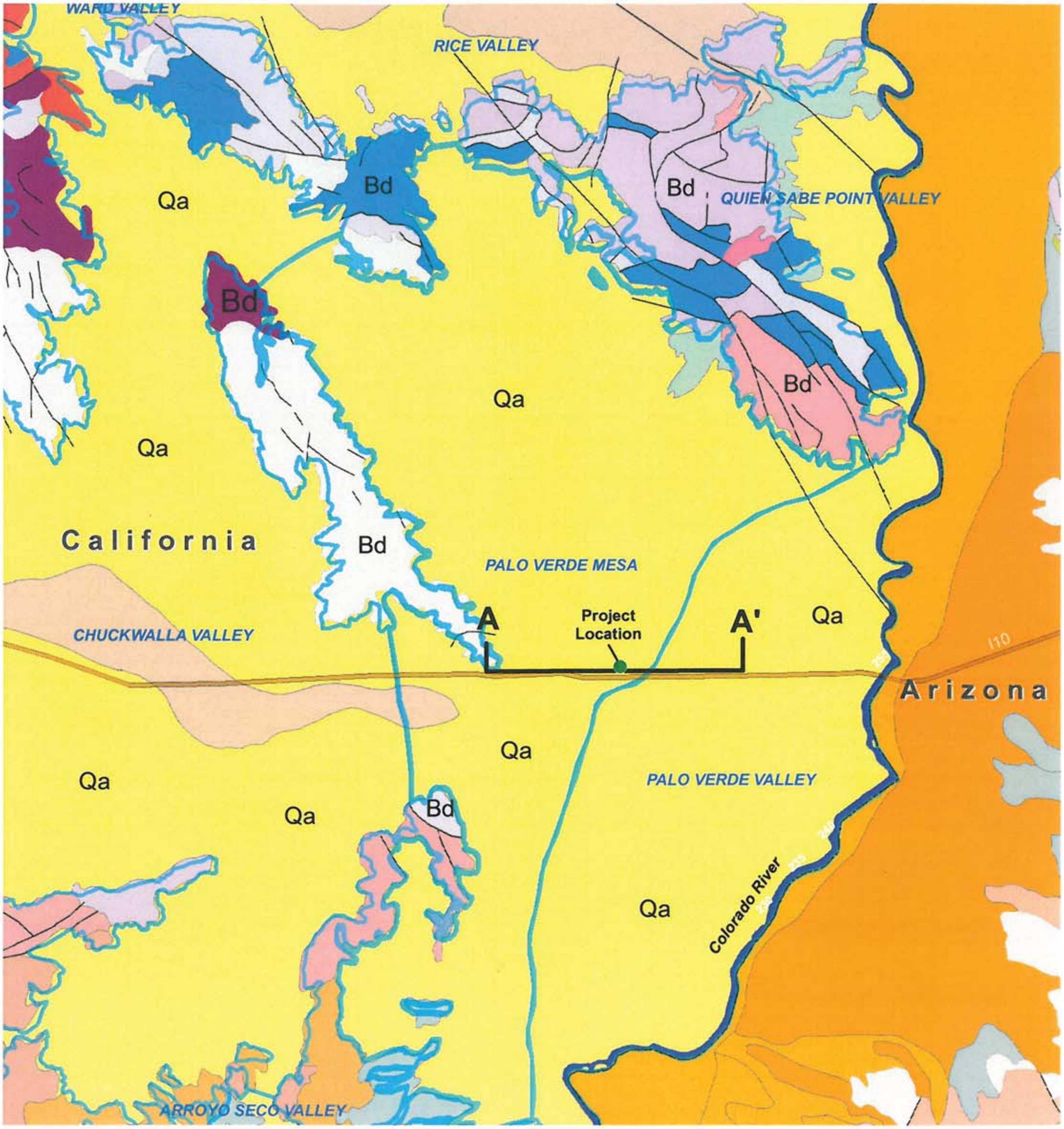
FIGURE 3
POTENTIOMETRIC SURFACE

Sonoran Energy Project
Blythe, California



Explanation

- Project Location
- West-East Cross-Section
- Groundwater Basins

Bd = Bedrock

Qa = Alluvium

— = Fault (dashed where inferred)

N

GCS WGS 1984
Datum of 1984
Prepared November 13, 2015

Sources: California Groundwater Basins 2015 (www.water.ca.gov shapefile), California Geology (mrdata.usgs.gov WMS Service)

This map was prepared for the purpose of identifying the location of general site features and water resources only and is not intended to provide a legal description or location of property ownership lines.

1 inch = 5 miles

0 1 2 3 4 5 Miles

FIGURE 4
AREAL GEOLOGY

Sonoran Energy Project
Blythe, California

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1 inch = 5 miles

0 1 2 3 4 5 Miles

Explanation

- Project Location
- Recharge / Discharge Paths
- Catchment (Approximately 165,000 Acres)
- Groundwater Basins

GCS WGS 1984
Datum of 1984
Prepared December 31, 2015

Sources: NAIP 2012 aerial imagery (map.dfg.ca.gov WMS Image Server), California Groundwater Basins 2015 (www.water.ca.gov shapefile)

This map was prepared for the purpose of identifying the location of general site features and water resources only and is not intended to provide a legal description or location of property ownership lines.

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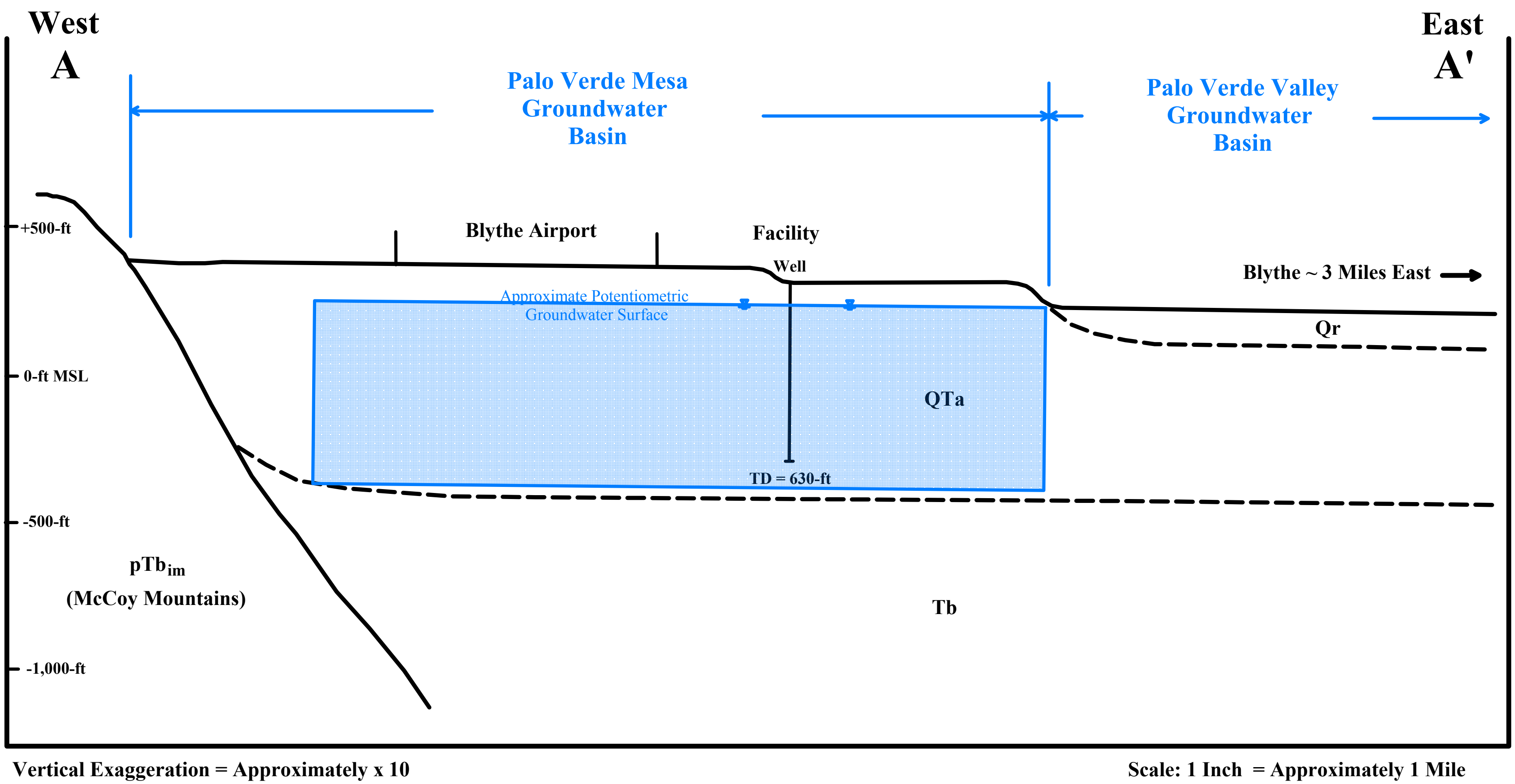
FIGURE 5
CATCHMENT AREA

Sonoran Energy Project
Blythe, California



Explanation

Qr = Younger Alluvium (Holocene Age)

QTa = Older Alluvium (Quaternary Age)

Tb = Bouse Formation (Tertiary Age)

pTb_{im} = Bedrock & Igneous Metamorphic (Tertiary and Pre-Tertiary)

[blue box] = Darcian Cross-Sectional Area

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FIGURE 6
WEST-EAST GENERALIZED HYDROGEOLOGIC CROSS-SECTION

Sonoran Energy Project
Blythe, California

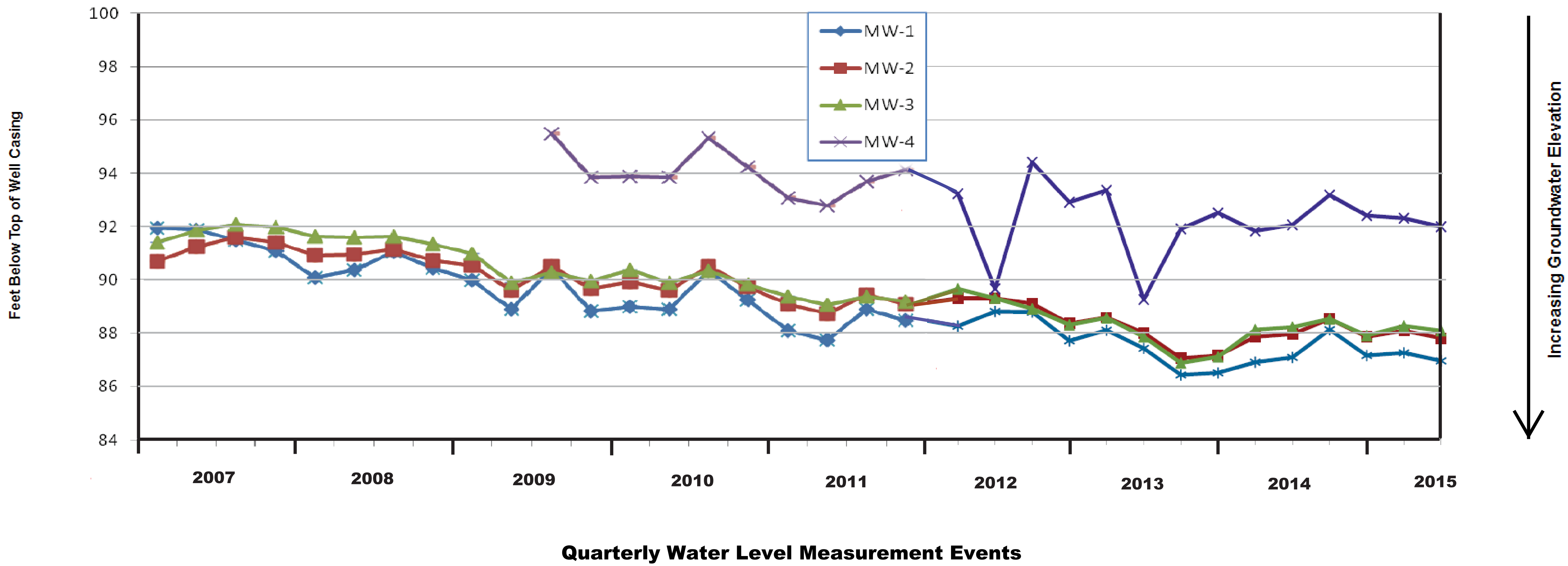

FIGURE 7
DEPTH TO WATER 2007-2015

Sonoran Energy Project
Blythe, California

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APPENDIX A

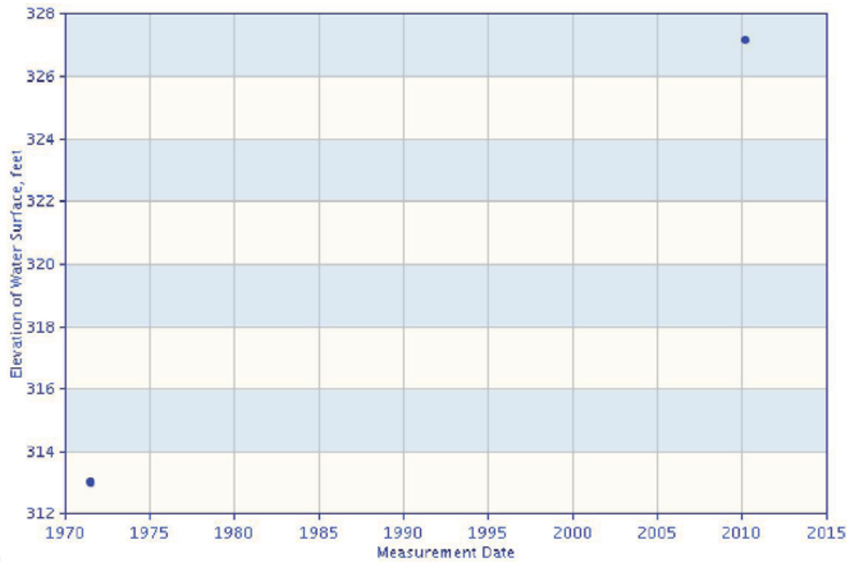
HYDROGRAPHS

Appendix A presents hydrographs for numerous groundwater wells in the vicinity of the Project site and Palo Verde Mesa Groundwater Basin.

Groundwater Level Data for Well 04S21E09B001S

Your selection returned a total of **2** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.

Groundwater Levels in Well 04S21E09B001S



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
07-01-1971	860.0	860.0	547.0	313.0	547.0			5000	
03-25-2010	874.7	874.7	547.5	327.2	547.5			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	705374	3747503	metres	11
LL	NAD27	114.7795	33.8478	decimal degrees	
LL	NAD83	114.7803	33.8478	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

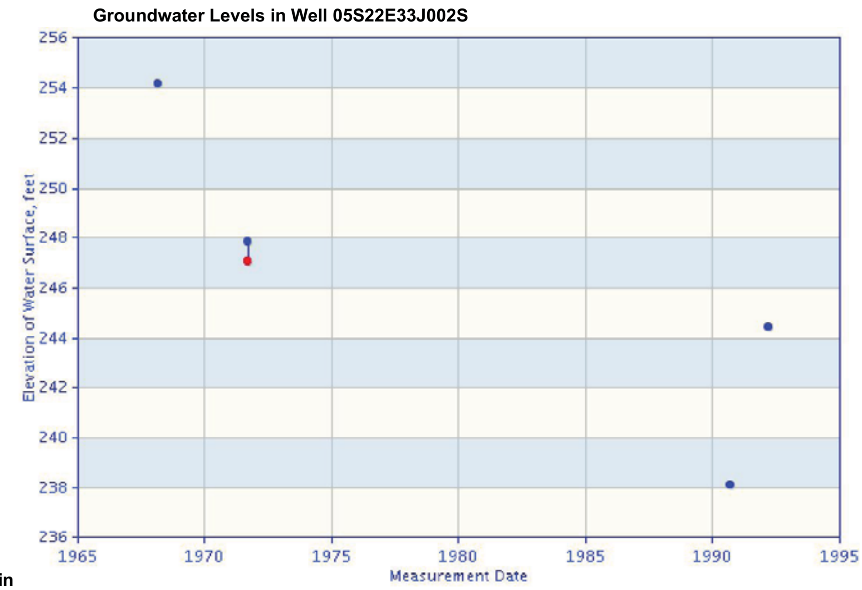
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 05S22E33J002S

Your selection returned a total of **5** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
03-01-1968	437.2	437.2	183.0	254.2	183.0			5000	
09-08-1971	437.2	437.2	190.2	247.0	190.2	4		5000	
09-09-1971	437.2	437.2	189.4	247.8	189.4			5000	
09-15-1990	437.2	437.2	199.1	238.1	199.1			5000	
03-21-1992	437.2	437.2	192.7	244.5	192.7			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	714830	3730909	metres	11
LL	NAD27	114.6814	33.6964	decimal degrees	
LL	NAD83	114.6822	33.6964	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

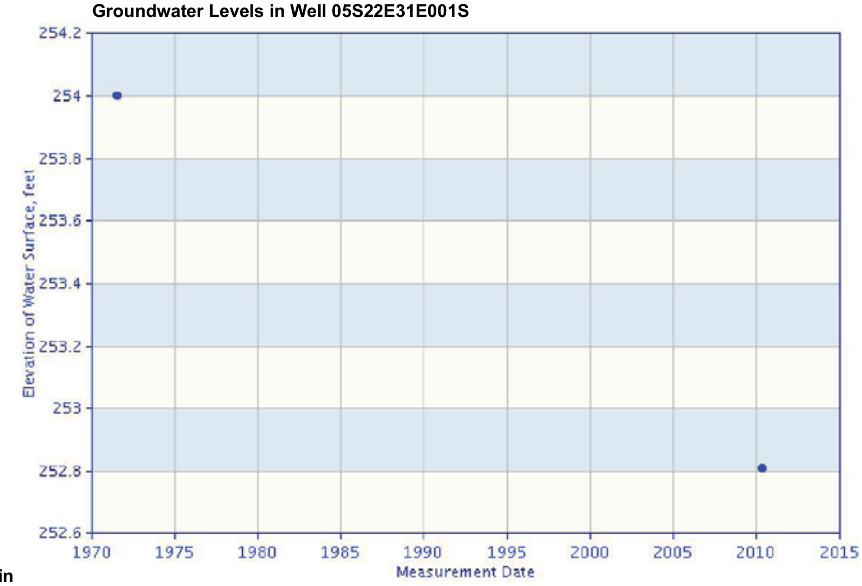
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 05S22E31E001S

Your selection returned a total of **2** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
08-01-1971	475.0	475.0	221.0	254.0	221.0			5000	
05-19-2010	475.8	475.8	223.0	252.8	223.0			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	710394	3731212	metres	11
LL	NAD27	114.7291	33.7000	decimal degrees	
LL	NAD83	114.7299	33.7000	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

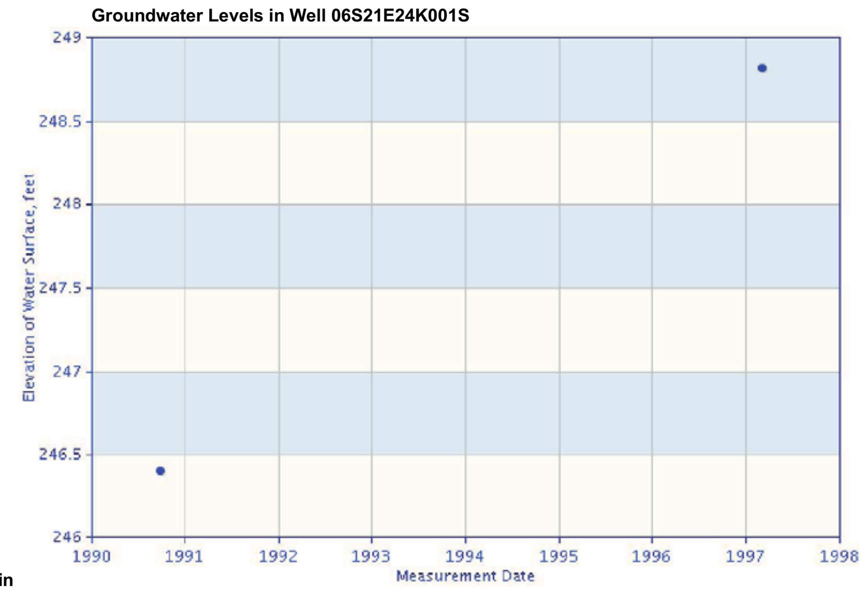
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S21E24K001S

Your selection returned a total of **2** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-26-1990	412.0	412.0	165.6	246.4	165.6			5000	
03-07-1997	412.0	412.0	163.2	248.8	163.2			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	709886	3724053	metres	11
LL	NAD27	114.7363	33.6356	decimal degrees	
LL	NAD83	114.7371	33.6356	decimal degrees	

Well Use: Undetermined

For more information contact:
Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

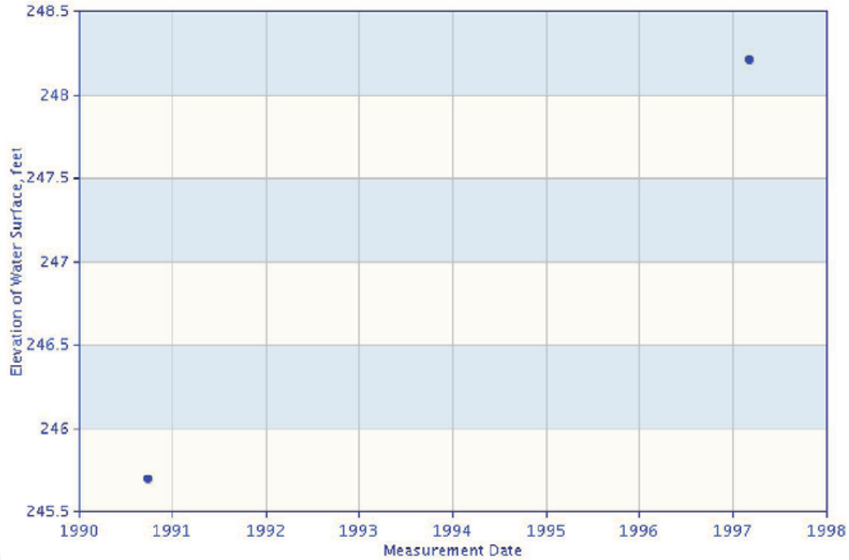
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S21E25A002S

Your selection returned a total of **2** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-26-1990	398.0	398.0	152.3	245.7	152.3			5000	
03-07-1997	398.0	398.0	149.8	248.2	149.8			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	710312	3723380	metres	11
LL	NAD27	114.7319	33.6295	decimal degrees	
LL	NAD83	114.7327	33.6295	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

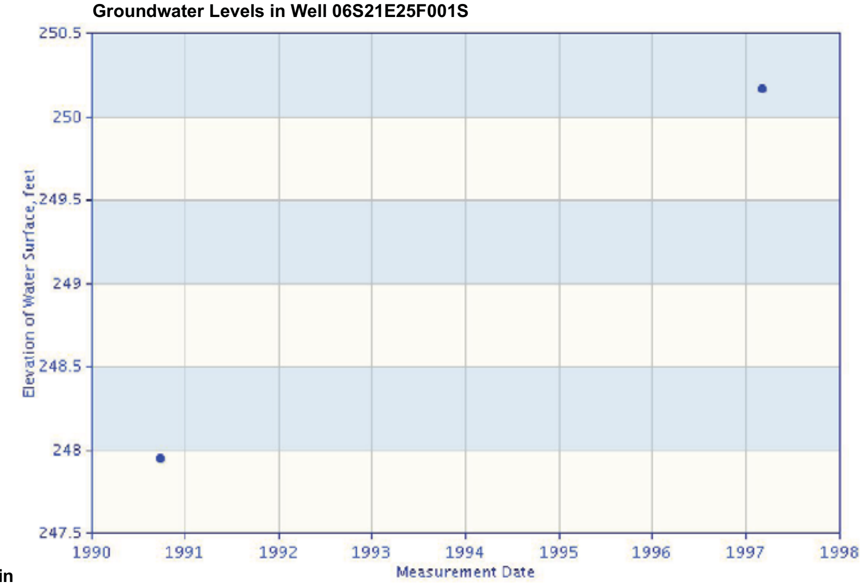
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S21E25F001S

Your selection returned a total of **2** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings									
Meas. Date	**R.P. Elev.**	**G.S. Elev.**	**RPWS**	**WSE**	**GSWS**	**QM Code**	**NM Code**	**Agency**	**Comment**
09-26-1990	415.0	415.0	167.1	248.0	167.1			5000	
03-07-1997	415.0	415.0	164.8	250.2	164.8			5000	

Well Coordinates					
Projection	**Datum**	**Easting**	**Northing**	**Units**	**Zone**
UTM	NAD27	709521	3723229	metres	11
LL	NAD27	114.7404	33.6283	decimal degrees	
LL	NAD83	114.7412	33.6283	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

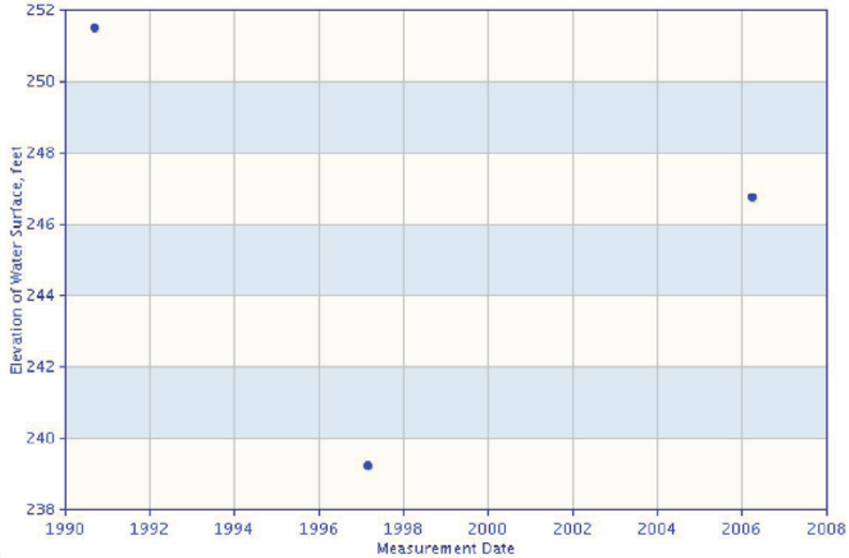
New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S21E25L001S

Your selection returned a total of **4** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.

Groundwater Levels in Well 06S21E25L001S



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-21-1990	400.0	400.0	148.5	251.5	148.5			5000	
03-07-1997	400.0	400.0	160.8	239.2	160.8			5000	
03-30-2006	400.2	400.2	153.5	246.8	153.5			5000	
03-30-2006	400.2	400.2	153.4	246.8	153.4			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	709537	3722423	metres	11
LL	NAD27	114.7404	33.6210	decimal degrees	
LL	NAD83	114.7412	33.6210	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

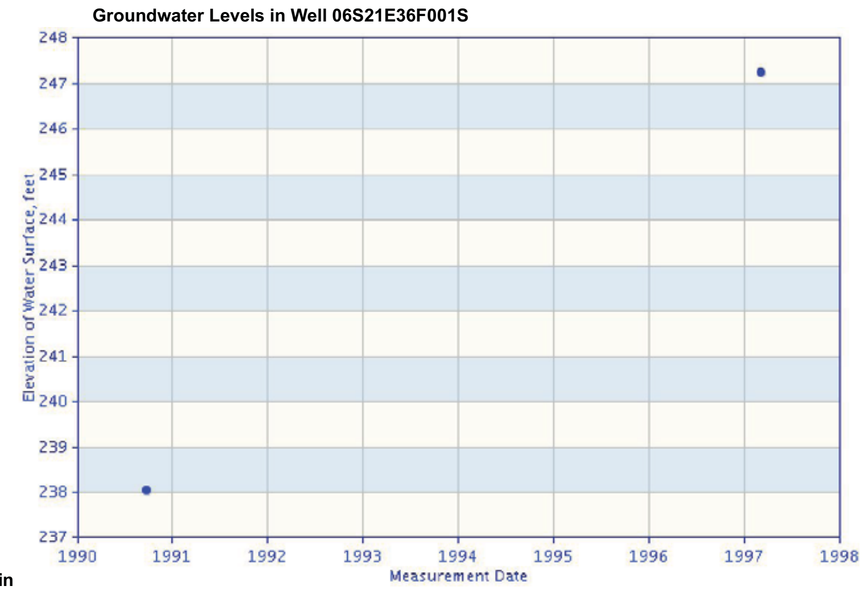
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S21E36F001S

Your selection returned a total of **2** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-21-1990	394.0	394.0	156.0	238.0	156.0			5000	
03-07-1997	394.0	394.0	146.8	247.2	146.8			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	709556	3721619	metres	11
LL	NAD27	114.7404	33.6137	decimal degrees	
LL	NAD83	114.7412	33.6137	decimal degrees	

Well Use: Undetermined

For more information contact:
Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

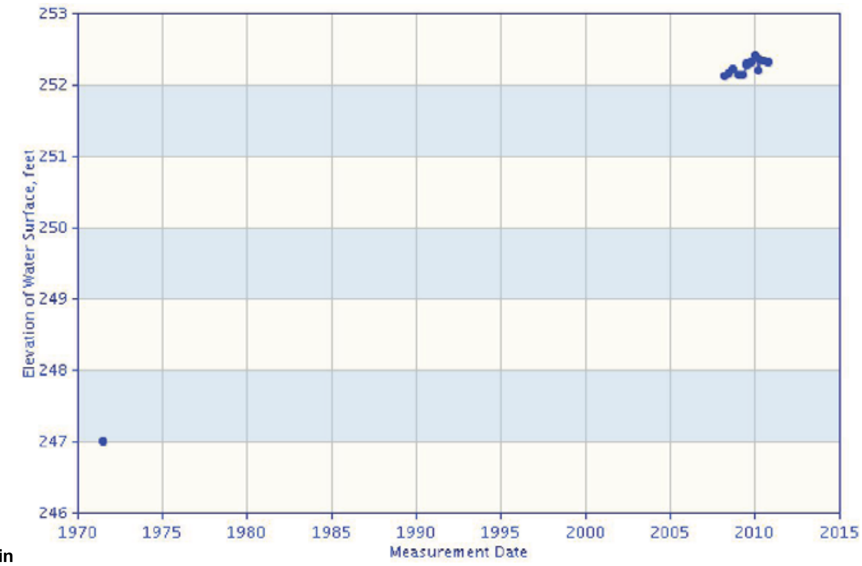
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S22E09P001S

Your selection returned a total of **22** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
07-01-1971	402.0	402.0	155.0	247.0	155.0			5000	
03-18-2008	399.6	399.6	147.5	252.1	147.5			5000	
06-25-2008	399.6	399.6	147.5	252.2	147.5			5000	
06-25-2008	399.6	399.6	147.4	252.2	147.4			5000	
09-23-2008	399.6	399.6	147.4	252.3	147.4			5000	
09-23-2008	399.6	399.6	147.4	252.2	147.4			5000	
01-13-2009	399.6	399.6	147.5	252.1	147.5			5000	
04-15-2009	399.6	399.6	147.5	252.1	147.5			5000	
07-30-2009	399.6	399.6	147.3	252.3	147.3			5000	
07-30-2009	399.6	399.6	147.3	252.3	147.3			5000	
07-31-2009	399.6	399.6	147.3	252.3	147.3			5000	
10-28-2009	399.6	399.6	147.3	252.3	147.3			5000	
10-28-2009	399.6	399.6	147.3	252.3	147.3			5000	
01-20-2010	399.6	399.6	147.2	252.4	147.2			5000	
01-20-2010	399.6	399.6	147.2	252.4	147.2			5000	
03-24-2010	399.6	399.6	147.4	252.2	147.4			5000	
04-21-2010	399.6	399.6	147.2	252.4	147.2			5000	
04-21-2010	399.6	399.6	147.2	252.4	147.2			5000	
07-21-2010	399.6	399.6	147.2	252.4	147.2			5000	
07-21-2010	399.6	399.6	147.3	252.4	147.3			5000	
11-03-2010	399.6	399.6	147.3	252.3	147.3			5000	
11-03-2010	399.6	399.6	147.3	252.3	147.3			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	714273	3726977	metres	11
LL	NAD27	114.6883	33.6611	decimal degrees	
LL	NAD83	114.6891	33.6611	decimal degrees	

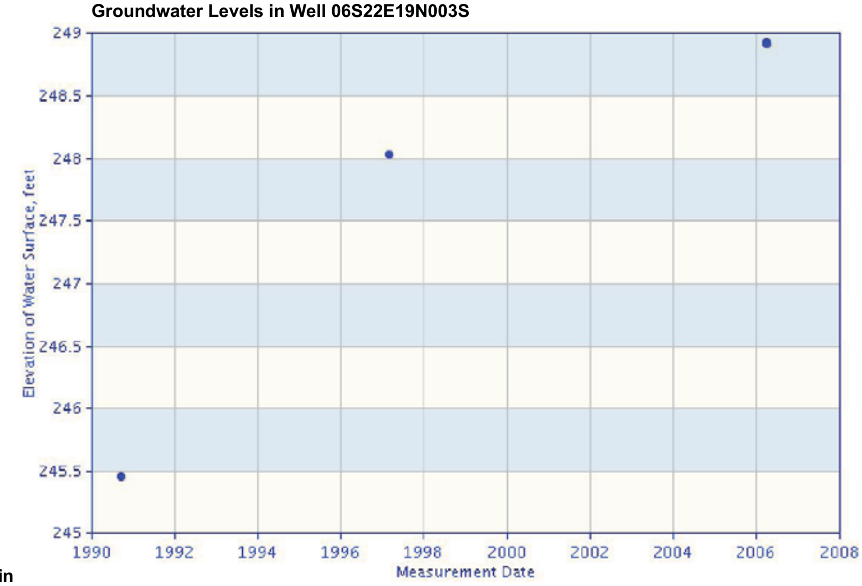
Well Use: Undetermined

For more information contact:
Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

Groundwater Level Data for Well 06S22E19N003S

Your selection returned a total of **4** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-23-1990	397.0	397.0	151.6	245.5	151.6			5000	
03-07-1997	397.0	397.0	149.0	248.0	149.0			5000	
04-04-2006	397.2	397.2	148.3	248.9	148.3			5000	
04-05-2006	397.2	397.2	148.3	248.9	148.3			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	711084	3723959	metres	11
LL	NAD27	114.7234	33.6345	decimal degrees	
LL	NAD83	114.7242	33.6345	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

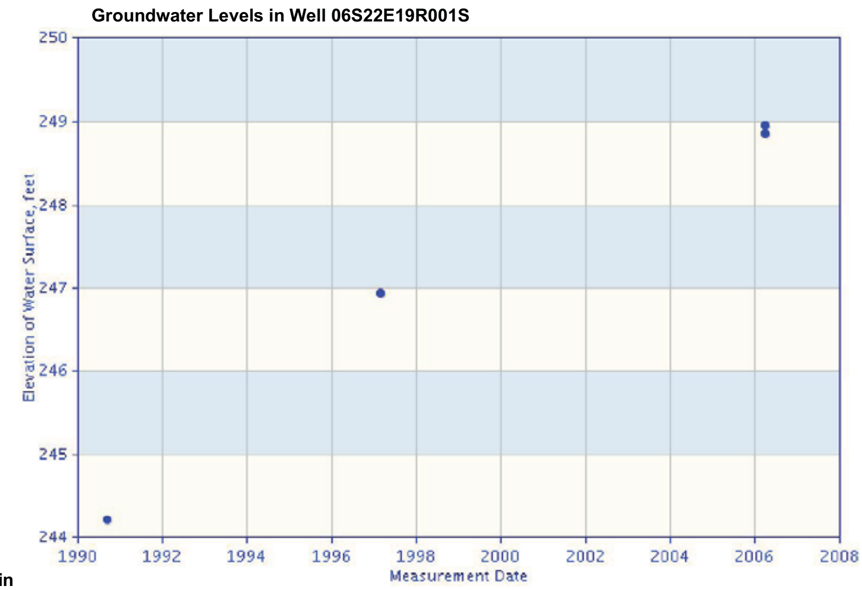
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S22E19R001S

Your selection returned a total of **4** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-23-1990	394.0	394.0	149.8	244.2	149.8			5000	
03-07-1997	394.0	394.0	147.1	246.9	147.1			5000	
04-04-2006	395.6	395.6	146.7	249.0	146.7			5000	
04-05-2006	395.6	395.6	146.8	248.9	146.8			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	712099	3723972	metres	11
LL	NAD27	114.7125	33.6344	decimal degrees	
LL	NAD83	114.7133	33.6344	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

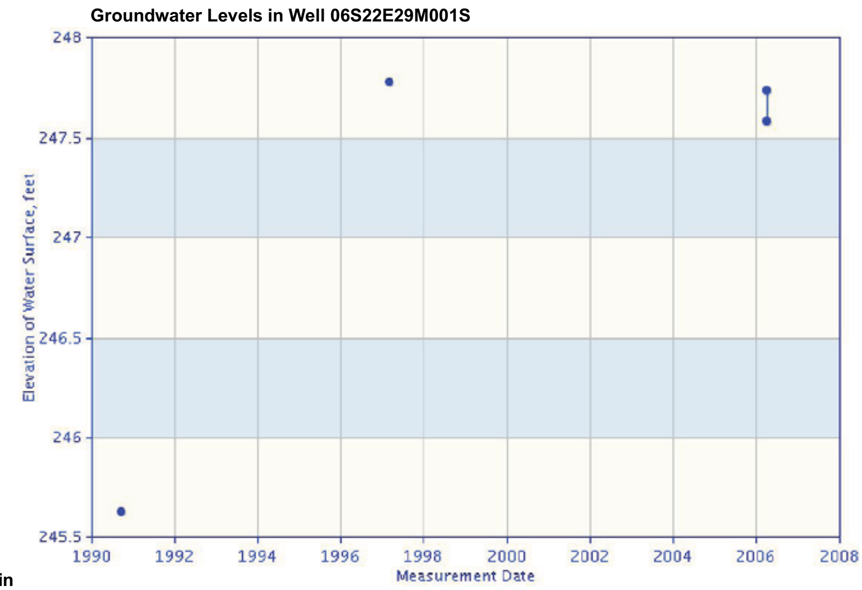
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S22E29M001S

Your selection returned a total of **4** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-24-1990	394.0	394.0	148.3	245.6	148.3			5000	
03-07-1997	394.0	394.0	146.2	247.8	146.2			5000	
04-04-2006	393.6	393.6	145.9	247.7	145.9			5000	
04-05-2006	393.6	393.6	146.0	247.6	146.0			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	712360	3722632	metres	11
LL	NAD27	114.7100	33.6223	decimal degrees	
LL	NAD83	114.7108	33.6223	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

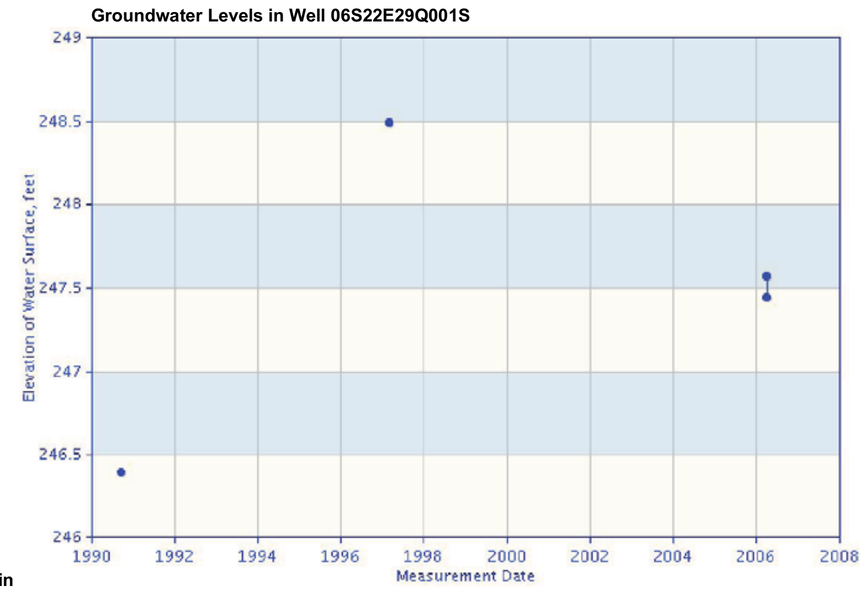
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S22E29Q001S

Your selection returned a total of **4** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-23-1990	390.7	390.7	144.3	246.4	144.3			5000	
03-07-1997	390.7	390.7	142.2	248.5	142.2			5000	
04-04-2006	390.6	390.6	143.0	247.6	143.0			5000	
04-05-2006	390.6	390.6	143.2	247.4	143.2			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	713251	3722113	metres	11
LL	NAD27	114.7005	33.6175	decimal degrees	
LL	NAD83	114.7013	33.6175	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

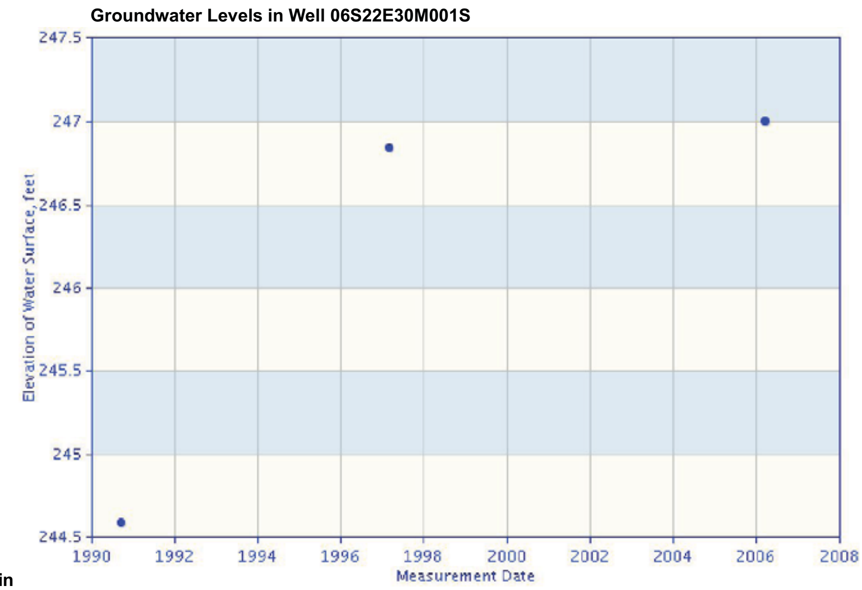
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S22E30M001S

Your selection returned a total of **4** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-26-1990	394.6	394.6	150.0	244.6	150.0			5000	
03-07-1997	394.6	394.6	147.8	246.8	147.8			5000	
03-30-2006	394.7	394.7	147.7	247.0	147.7			5000	
03-30-2006	394.7	394.7	147.7	247.0	147.7			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	710873	3722768	metres	11
LL	NAD27	114.7259	33.6238	decimal degrees	
LL	NAD83	114.7267	33.6238	decimal degrees	

Well Use: Undetermined

For more information contact:
Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

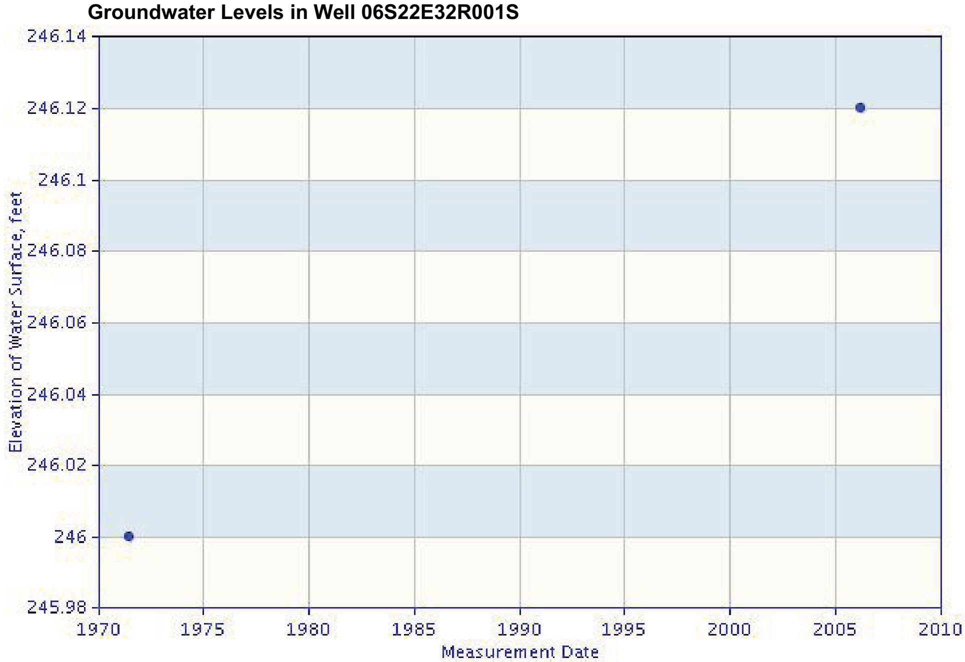
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S22E32R001S

Your selection returned a total of **2** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
07-01-1971	332.0	332.0	86.0	246.0	86.0			5000	
03-31-2006	334.2	334.2	88.1	246.1	88.1			5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	713977	3720658	metres	11
LL	NAD27	114.6930	33.6042	decimal degrees	
LL	NAD83	114.6938	33.6042	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

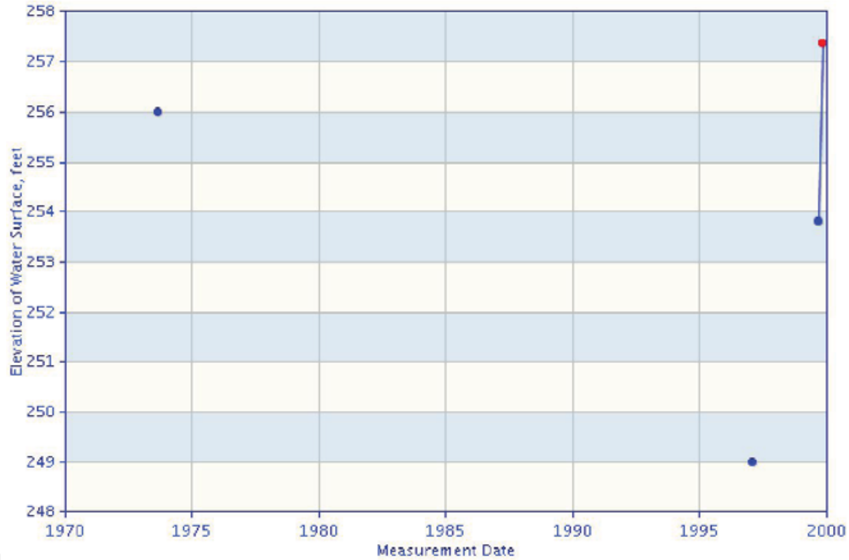
Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

Groundwater Level Data for Well 06S23E29N003S

Your selection returned a total of **6** records. Wells in the Department of Water Resources monitoring network are identified by a State Well Number, which is based on the Public Land Grid System. The table headings and records contain several codes and abbreviations. Press the ***New Search*** or ***Nearby Search*** buttons or at the bottom of the page to begin a new data retrieval. Data for this well can also be downloaded in MS Excel or text delimited format.



Palo Verde Mesa Groundwater Basin

NOTE: red circles denote questionable measurements. Please see the data table below for specifics.

Groundwater Level Readings

Meas. Date	R.P. Elev.	G.S. Elev.	RPWS	WSE	GSWS	QM Code	NM Code	Agency	Comment
09-12-1973	270.0	270.0	14.0	256.0	14.0			5000	
01-28-1997	270.0	270.0	21.0	249.0	21.0			5000	
09-02-1999	270.0	270.0	16.2	253.8	16.2			5000	
11-18-1999	270.0	270.0	12.6	257.4	12.6	4		5000	
11-18-1999	270.0	270.0	12.6	257.4	12.6	4		5000	
11-18-1999	270.0	270.0	12.6	257.4	12.6	4		5000	

Well Coordinates

Projection	Datum	Easting	Northing	Units	Zone
UTM	NAD27	722361	3722747	metres	11
LL	NAD27	114.6022	33.6213	decimal degrees	
LL	NAD83	114.6030	33.6213	decimal degrees	

Well Use: Undetermined

For more information contact:

Department of Water Resources, Southern District
Groundwater Section
770 Fairmont Avenue
Glendale, CA 91203

Phone: 818-500-1645, ext. 233
Fax: 818-543-4604

New Search

Search for wells within 0.5 mile radius. Nearby Search

National Water Information System: Web Interface

USGS Water Resources
Data Category: Groundwater
Geographic Area: United States
GO

Click to hideNews Bulletins

- August 8, 2013
- Try our new Mobile-friendly water data site from your mobile device!
- New improved user interface.
- Full News

Groundwater levels for the Nation

Search Results -- 1 sites found

site_no list =

- 333939114411501

Minimum number of levels = 1

Save file of selected sites to local disk for future upload

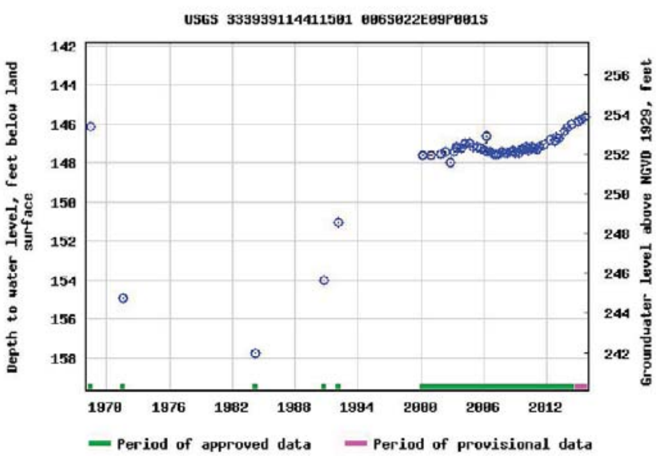
USGS 333939114411501 006S022E09P001S

Groundwater: Field measurements GO

Riverside County, California
Hydrologic Unit Code 15030104
Latitude 33°39'39.83", Longitude 114°41'15.03" NAD27
Land-surface elevation 399.6 feet above NGVD29
The depth of the well is 252 feet below land surface.
The depth of the hole is 276 feet below land surface.
This well is completed in the Basin and Range basin-fill aquifers (N100BSNRGB) national aquifer.

Output formats

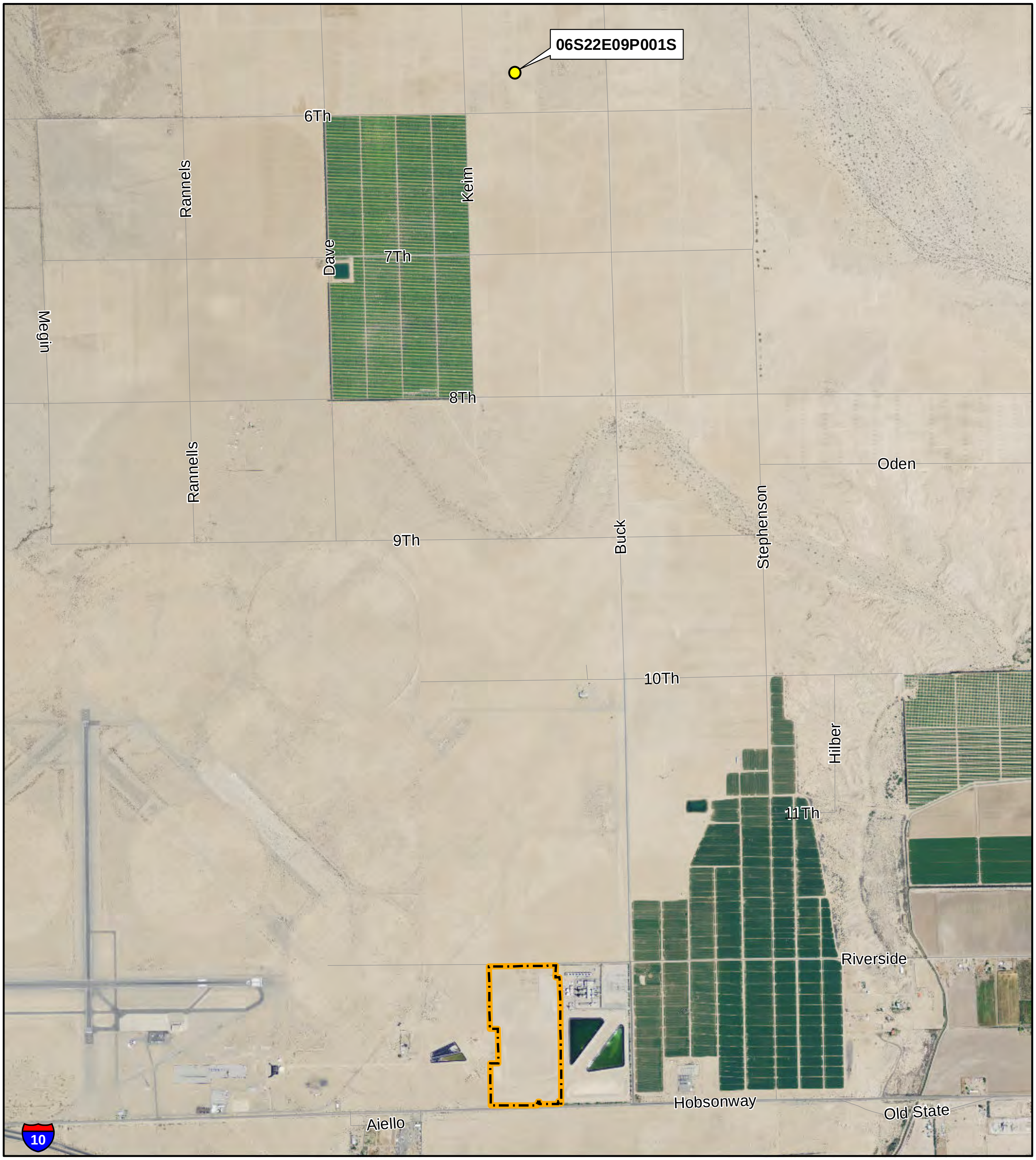
Table of data
Tab-separated data
Graph of data
Reselect period

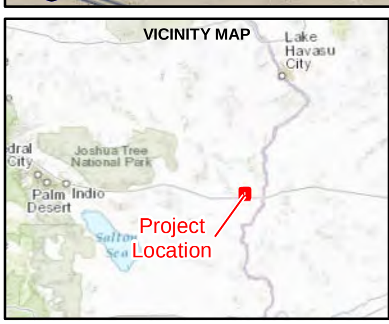


Breaks in the plot represent a gap of at least one year between field measurements.
Download a presentation-quality graph

Questions about sites/data?
Feedback on this web site
Automated retrievals
Help
Data Tips
Explanation of terms
Subscribe for system changes
News

ATTACHMENT B





LEGEND

- Well Location
- Property Boundary

N

0 0.25 0.5
Miles

PV Mesa Well 06S22E09P0015 Location
Sonoran Energy Project
Riverside County, California

Image Source: NAIP 2012

\\BALDUR\PROJ\SEP\MAPFILES\SEP_PROJECTLOCATION_20160328.MXD MD013761 3/28/2016 2:10:31 PM

ch2m

ATTACHMENT C

CALENDAR YEAR 2014
FALLOWED LAND VERIFICATION REPORT

PVID/MWD Forbearance and Fallowing Program

Palo Verde Irrigation District,
The Metropolitan Water District of Southern California, and
U.S. Bureau of Reclamation

Final
May 14, 2015

CALENDAR YEAR 2014
FALLOWED LAND VERIFICATION REPORT

Executive Summary

On January 1, 2005, the Palo Verde Irrigation District (PVID) and The Metropolitan Water District of Southern California (MWD) initiated a 35-year "Forbearance and Fallowing Program" (Program) with landowners within PVID. A total of 25,947 acres were enrolled. Participating landowners started fallowing on behalf of the Program on January 1, 2005. The Program is termed to end on July 31, 2040. Water that would have been used to grow crops on the fallowed land is made available to MWD.

In July 2011, Metropolitan issued a fallowing call for minimum fallowing for Contract Years 2012/13 and 2013/14 (August 1, 2012 through July 31, 2014) , i.e., 25% of the landowners' maximum commitments.

In July 2012, Metropolitan did not issue a fallowing call for Contract Years 2013/14 and 2014/15 (August 1, 2013 through July 31, 2015). Instead a letter was sent informing the participants to continue minimum fallowing per the July 2011 fallowing call.

In July 2013, Metropolitan issued a fallowing call for Contract Years 2014/15 and 2015/16 (August 1, 2014 through July 31, 2016) at 50% of the landowners' maximum commitments.

Therefore for calendar year 2014, from January 1, 2014 through July 31, 2014, fallowing was at the minimum 25% call. The fallowed acreage of 6,493 acres is slightly higher than the minimum (e.g., 25 percent of 25,947 acres is 6,486 acres) due to the rounding up or down of each contract to the nearest acre, and to accommodate three contracts, 4 acres were waived from fallowing in the Program. Then starting August 1, 2014 and through December 31, 2014, the fallowing call at the 50% level increased fallowed acreage to an anticipated 12,997 acres. However, a participating landowner initially enrolled 22 acres as part of his contract commitment to the Program. But upon verification, the land did not satisfy the Program's eligibility prerequisites to participate. Unfortunately, a resolution was not reached, resulting in a reduction of the landowner's annual payment for those 22 acres and a corresponding reduction in the total acres fallowed. Therefore, at the 50% level, from August 1st through December 31st total fallowed acreage was 12,975 acres.

Through the act of fallowing, water is saved. However, the exact amount of water saved is difficult to quantify. Because of the Program's existence, the types and acreage of crops that would have been grown on the fallowed lands and hence the exact amount that has been saved through fallowing will never be known.

Two methods were used to estimate the water savings. Under the first method (Historical Use Method), three periods of past years deemed representative of historical conditions in PVID were selected and irrigation water use rates during each period were calculated and used to estimate water savings from the fallowed lands for calendar year 2014. Under the second method (Actual Use Method), irrigation water use rates on irrigated lands during calendar year 2014 were calculated and used to estimate water savings from the fallowed fields. The resulting estimates of saved water by each method are shown in Table E-1.

Table E-1: Estimates of Saved Water by Method – Calendar Year 2014

Method	Saved Water (acre-feet)
12-Year Average (1988-2002)*	38,591
5- Year Average (1998-2002)	40,522
3- Year Average (2000-2002)	42,647
Actual Use Method - CY 2014	43,010

*1992, 1993 and 1994 data were not included in the analysis. From 1992 through 1994, the PVID-MWD Test Fallowing Program was conducted.

Estimates of water saved by the Program in calendar year 2014 ranged from 38,591 acre-feet to 43,010 acre-feet. The Actual Use Method is deemed the method most reflective of the agronomic, weather, and market conditions prevailing in the Palo Verde Valley during calendar year 2014. As such, the best estimate of the amount of water saved during calendar year 2014 is 43,010 acre-feet.

CALENDAR YEAR 2014
FALLOWED LAND VERIFICATION REPORT
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CALENDAR YEAR 2014
FALLOWED LAND VERIFICATION REPORT

1.0 Program Description

On January 1, 2005, the Palo Verde Irrigation District (PVID) and The Metropolitan Water District of Southern California (MWD) initiated a 35-year "Forbearance and Fallowing Program" (Program) with landowners within PVID that would extend through July 31, 2040. Participation in the Program is voluntary but requires participating landowners to sign a 35-year participation contract. A total of 25,947 acres are enrolled in the Program. MWD paid participating landowners a one-time signup payment for enrolling their lands in the Program and fallowing lands in response to MWD's annual fallowing calls. In addition, MWD compensates participating landowners with annual payments for fallowing land within PVID that is served with Priority 1 Colorado River water delivered by PVID. In return for the payments, the water that would have been used to grow crops on the fallowed lands is made available to MWD.

2.0 Palo Verde Irrigation District

The Palo Verde Irrigation District Act was passed by the California Legislature in 1923. PVID was then organized and began functioning in 1925. Governance is provided by a 7-member Board of Trustees. Administration is provided through a General Manager and a staff of 65, currently, not counting Board members. PVID presently covers about 189 square miles in Riverside and Imperial Counties of California. The principal city in PVID's service area is Blythe which, with its urban fringe, has a population of about 21,800 people. Currently, PVID contains approximately 131,285 acres with 104,485 acres located in the Palo Verde Valley (Valley) portion of PVID and 26,800 acres located on the adjacent Palo Verde Mesa (Mesa). PVID diverts water from the Colorado River, which is regulated by the U.S. Bureau of Reclamation (Reclamation).

The Valley with its long, hot growing season is ideal for agriculture. Crops include vegetables, forage, grains and fibers. Mild winters, with a minimum of frost, permit the growing and harvesting of crops throughout the year.

Climatic data for temperature, precipitation and evapotranspiration (ET_o) in the Valley for the period 1988-2014 are shown in Table 1. The highest maximum annual average temperature was 93.03° Fahrenheit (F) in 2003; and the lowest minimum annual average temperature was 52.81° F in 2011. Annual rainfall ranged between a low of 0.72 inches in 2000 to a high of 6.49 inches in 1998. Annual ET_o varied between a low of 65.05 inches in 2012 at Ripley to a high of 79.32 inches in 1994 at Palo Verde.

Table 1: Climatic Data, Palo Verde Valley, California – 1988-2014

Year	Maximum Annual Average Temperature[1]	Minimum Annual Average Temperature[1]	Annual Rainfall[2]	ET_o Palo Verde[3]	ET_o Blythe NE[4]	ET_o Ripley[5]
	(Fahrenheit)	(Fahrenheit)	(inches)	(inches)	(inches)	(inches)
1988	88.5	57.1	3.53	72.3		
1989	90.1	54.9	1.26	68.99		
1990	88.2	56.3	1.66	73.04		
1991	86.5	55.8	4.32	68.75		
1992	87.5	58.6	6.21	70.47		
1993	88.7	57.2	5.05	77.15		
1994	88.5	57.4	3.4	79.32		
1995	89.2	58.3	2.53	73.55		
1996	90.1	59.6	2.34	73.53		
1997	88.4	58.3	5.79	68.2	69.03	
1998	86.5	56.8	6.49	68.42	66.71	
1999	88.5	56.3	3.2	70.58	72.52	69.67
2000	89.4	58.6	0.72	68.81	69.13	67.22
2001	89.5	56.1	4.78	69.11	67.5	68.81
2002	89.2	57.2	0.76	71.09	72.41	69.34
2003	93.03	60.32	2.68	67.26	68.46	67.15
2004	91.9	59.55	2.57	66.78	66.64	67.69
2005	87.11	55.77	6.39	65.66	67.11	65.13
2006	90.5	57.9	1.57	69.6	75.5	67.9
2007	88.57	59.89	1.93	69.85	73.38	68.27
2008	89.65	57.48	2.41	71.47	73.69	68.18
2009	85.39	52.83	1.31	68.05	70.77	71.42
2010	84.58	54.08	2.56	64.72	72.42	67.02
2011	84.7	52.81	2.41	72.69	68.41	69.51
2012	86.39	54.11	3.36	66.70	67.60	65.05
2013	85.71	53.49	2.32	66.33	70.20	66.94
2014	86.95	54.63	3.31[6]	67.57	71.70	69.51
Average	**88.27**	**56.72**	**3.14**	**70.00**	**70.18**	**68.05**

[1] National Oceanic and Atmospheric Administration (NOAA) data from Blythe Station except for October 1997; August, September, and November 1999; January and December 2000; December 2001; and October 2006 when NOAA values from Blythe Airport Station were used because of missing data. Starting 2009, data are averages of the three California Irrigation Management Information System (CIMIS) stations at Palo Verde, Blythe, and Ripley.
[2] Data through 2008 from NOAA Blythe Station, and starting in 2009, data are averaged from the three CIMIS stations at Palo Verde, Blythe, and Ripley.
[3] Data from Palo Verde CIMIS station #72 for 1988-2000; and from Palo Verde II CIMIS station #175 for 2001 onward.
[4] Data from Blythe Northeast CIMIS station #135.
[5] Data from Ripley CIMIS station #151.
[6] The CIMIS station #175 (in Palo Verde) rainfall gauge was offline in 2014.

3.0 The Metropolitan Water District of Southern California

MWD was incorporated in 1928 and currently has 26 member agencies. Governance is provided by a 37-member Board of Directors with each member agency entitled to be represented by one director with representation by additional directors being based on assessed valuation. Administration is provided through a General Manager and a staff of currently 1,827 employees.

MWD provides supplemental water supplies to its service area from two sources: 1) MWD's Colorado River Aqueduct; and 2) the Department of Water Resources' State Water Project/California Aqueduct. Water is provided to approximately 18.5 million people, in a service area of approximately 5,200 square miles consisting of areas that are in portions of Los Angeles, Orange, San Diego, Riverside, San Bernardino, and Ventura counties of California. MWD has increased its ability to supply water, particularly in dry years, through the implementation of storage, conservation, and transfer programs.

On October 10, 2003, the United States, Imperial Irrigation District, Coachella Valley Water District, MWD, and San Diego County Water Authority executed the "Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement for purposes of Section 5(B) of the Interim Surplus Guidelines" (Delivery Agreement). Under the Delivery Agreement, MWD agreed that if consumptive use of Colorado River water in accordance with Priorities 1 and 2 of the contracts for delivery of Colorado River water in California, together with the use of Colorado River water on PVID Mesa lands in accordance with Priority 3(b), exceeds 420,000 acre-feet in a calendar year, the Secretary of the Interior (Secretary) will reduce the amount of water otherwise available to MWD, by the amount that such use exceeds 420,000 acre-feet. To the extent that the amount of water used in accordance with Priorities 1, 2, and 3(b) is less than 420,000 acre-feet in a year, the Secretary will deliver to MWD the difference. For the purposes of the Delivery Agreement, "consumptive use" means diversions from the Colorado River less such measured and unmeasured return flow thereto as is available for consumptive use in the United States or in satisfaction of the Mexican treaty obligation.

4.0 Program Implementation

Under the Program, MWD issues a yearly fallowing call to participating landowners a year in advance of the fallowing start date of August 1. Each fallowing call is for a two-year period and once issued, may not be rescinded or diminished.

In July 2011, Metropolitan issued a fallowing call for minimum fallowing for Contract Years 2012/13 and 2013/14 (August 1, 2012 through July 31, 2014), i.e., 25% of the landowners' maximum commitments.

In July 2012, Metropolitan did not issue a fallowing call for Contract Years 2013/14 and 2014/15 (August 1, 2013 through July 31, 2015). Instead a letter was sent informing the participants to continue minimum fallowing per the July 2011 fallowing call.

In July 2013, Metropolitan issued a fallowing call for Contract Years 2014/15 and 2015/16 (August 1, 2014 through July 31, 2016) at 50% of the landowners' maximum commitments.

Therefore for calendar year 2014, from January 1, 2014 through July 31, 2014, fallowing was at the minimum 25% call. The fallowed acreage of 6,493 acres is slightly higher than the minimum (e.g., 25 percent of 25,947 acres is 6,486 acres) due to the rounding up or down of each contract to the nearest acre, and to accommodate three contracts, 4 acres were waived from fallowing in the Program. Then starting August 1, 2014 and through December 31, 2014, the fallowing call at the 50% level increased fallowed acreage to an anticipated 12,997 acres. However, a participating landowner initially enrolled 22 acres as part of his contract commitment to the Program. But upon verification, the land did not satisfy the Program's eligibility prerequisites to participate. Unfortunately, a resolution was not reached, resulting in a reduction of the landowner's annual payment for those 22 acres and a corresponding reduction in the total acres fallowed. Therefore, at the 50% level, from August 1st through December 31st total fallowed acreage was 12,975 acres.

Table 2 shows the fallowed acreage per month. Attachment 1 shows the fallowed fields on January 1, 2014 and Attachment 2 shows the fallowed fields on December 31, 2014. All fallowed acres designated by the participants were qualified by PVID for fallowing eligibility, i.e., entitled to receive Priority 1 water and had been irrigated and a crop had been harvested at least once during the past five years. Following the designation of fallowed acreage, a MWD representative visited the field before the date fallowing was to commence, verified fallowing conditions had been met and took photographs as needed to document the fallow status of fields. The same procedure was followed when participants would make changes in the acreage and/or location of fallowed lands at various points in time during the year thus ensuring that only qualified land is being fallowed. In addition, Reclamation staff conducted semi-annual field inspections, in March and October 2014, to verify the status of fallowed fields under the Program. In each field inspection, about five percent of the total fallowed acreage was randomly selected and inspected and the fallow status documented. Copies of Reclamation's verification reports are available upon request from Reclamation staff in Boulder City, Nevada.

Table 2: Fallowed Valley Lands – Calendar Year 2014

Month	At Start of Month	Average for Month
Jan	6,493	6,493
Feb	6,493	6,493
Mar	6,493	6,493
Apr	6,493	6,493
May	6,493	6,493
Jun	6,493	6,493
Jul	6,493	6,493
Aug	12,975	12,975
Sep	12,975	12,975
Oct	12,975	12,975
Nov	12,975	12,975
Dec	12,975	12,975
Yearly Average	9,194	9,194

5.0 Saved Water

The purpose of the Program is to save water that would have been otherwise used for agricultural production in PVID. In order to estimate the amount of water saved, it is necessary to estimate the amount of water that would have been consumed on the fallowed lands had crops been produced. Through the act of fallowing, water is saved. However, the exact amount of water saved is difficult to quantify. Because of the Program's existence, the types and acreage of crops that would have been grown on the fallowed lands and hence the exact amount that has been saved through fallowing will never be known. Therefore, it was necessary to develop acceptable procedures to estimate the amount of saved water to the degree of accuracy allowed by available data.

Two methods were used to estimate the amount of water saved during calendar year 2014. Under the first method (Historical Use Method), three periods of past years deemed representative of conditions in PVID were selected and estimated irrigation water use rates during each period were calculated and used to estimate water savings from the fallowed lands during calendar year 2014. Under the second method (Actual Use Method), estimated irrigation water use rates on irrigated lands during calendar year 2014 were calculated and used to estimate water savings from the fallowed fields during calendar year 2014.

6.0 Historical Use Method

Three historical periods were selected that were deemed representative of typical conditions in PVID when cropping practices were not influenced by outside factors such as an impending fallowing program or a return to irrigation following a fallowing program. Three periods were selected: 12 years, 5 years, and 3 years; and three separate analyses were conducted.

6.1 12-Year Average: 1988-2002 (Excluding 1992-94)

The first period extended from 1988 through 2002, but excluded 1992, 1993, and 1994 because the August 1992-July 1994 PVID/MWD Test Fallowing Program affected water use and the amount of cropped acreage during those three years. This adjustment left 12 years of data for the analysis. Diversions at the Palo Verde Diversion Dam were tabulated by month for each year in the analysis. The 12 data values for each month were averaged, and the resulting averages for each month were summed to determine the average annual diversion.

Similarly, water deliveries to the PVID Mesa were tabulated by month. Diversions at the Palo Verde Diversion Dam were then reduced by measured returns, unmeasured returns, and deliveries to the Mesa; the resulting net diversions were used to estimate the amount of irrigation water used by the Valley lands of PVID. PVID's unmeasured returns are an estimated value, calculated as 5.6% of PVID's total diversions. Since water diverted by PVID is delivered to farmland only for irrigation purposes, it is assumed the estimated amount of irrigation water used by the Valley lands is a good estimate of the amount of water used by crops on the Valley lands. Diversions and cropped acreage for lands upstream of the Palo Verde Diversion Dam were not included in the analysis. Table 3 shows the tabulation for each month, which when summed, results in an estimated average annual crop water use of 400,512 acre-feet.

Table 3: Estimated Irrigation Water Use on Valley Lands – 1988–2002[1]

Month	Gross Diversions	Measured & Unmeasured Return Flows [2]	Deliveries to Mesa	Estimated Irrigation Water Use on Valley Lands
	(acre-feet)			
Jan	31,460	30,191	210	1,059
Feb	52,419	32,927	403	19,089
Mar	71,357	38,837	639	31,881
Apr	87,610	41,522	948	45,140
May	102,507	46,644	1,169	54,694
Jun	109,957	48,197	1,273	60,487
Jul	116,762	50,094	1,371	65,297
Aug	108,093	52,536	1,385	54,172
Sep	79,391	48,362	987	30,042
Oct	65,820	45,938	787	19,095
Nov	49,483	40,725	528	8,230
Dec	51,782	39,908	548	11,326
Yearly Average	926,641	515,881	10,248	400,512

[1] 1992, 1993 and 1994 data were not included due to the 1992-94 PVID-MWD Test Fallowing Program. This reduced the data series to 12 years.
[2] Source of Gross Diversions, Measured and Unmeasured Return Flows data is Reclamation records. Source of Deliveries to Mesa data is PVID records.

Over the same 12-year period of data, the irrigated acreage on Valley lands averaged 88,053 water toll acres (Table 4). Dividing the estimated average annual irrigation water use of 400,512 acre-feet by 88,053 water toll acres resulted in an estimated average annual irrigation water use of 4.55 acre-feet per water toll acre. The next step is to extrapolate the irrigation water use per acre estimate to the fallowed lands in calendar year 2014.

Table 4: Farmed Acreage in Valley Portion of PVID – 1988-1991 and 1995-2002[1]

Year	Cropped Land (water toll acres)	Year	Cropped Land (water toll acres)	Year	Cropped Land (water toll acres)
1988	87,086	1995	88,243	1999	88,910
1989	86,701	1996	88,721	2000	88,709
1990	86,561	1997	88,645	2001	88,901
1991	86,601	1998	88,921	2002	88,633
				Average	88,053

[1] 1992, 1993, and 1994 farmed acreages are not included due to the 1992-94 PVID-MWD Test Fallowing Program; 2003 farmed acreage is not included due to the Coachella Valley Water District Fallowing Program; and 2004-2014 farmed acreages are not included due to the current PVID-MWD Fallowing Program. Source: PVID records.

The estimated values of monthly irrigation water use on Valley lands shown in Table 3 were converted to percentages of the yearly total as shown in Table 5. Applying the resulting monthly percentages to the average annual irrigation use estimate of 4.55 acre-feet per water toll acre resulted in an estimate of the monthly irrigation water use factors on Valley lands. These estimated monthly irrigation water use factors on Valley lands were used to provide a reasonable estimate of saved water by fallowed fields in PVID during calendar year 2014.

Table 5: Estimated Irrigation Water Use Factors on Valley Lands – 1988-2002[1]

Month	Estimated Irrigation Water Use on Valley Lands (acre-feet)	Percent of Yearly Total (%)	Estimated Irrigation Water Use Factors on Valley Lands (acre-feet/acre)
Jan	1,059	0.264412	0.012031
Feb	19,089	4.766149	0.216860
Mar	31,881	7.960061	0.362183
Apr	45,140	11.270574	0.512811
May	54,694	13.656020	0.621349
Jun	60,487	15.102419	0.687160
Jul	65,297	16.303382	0.741804
Aug	54,172	13.525687	0.615419
Sep	30,042	7.500899	0.341291
Oct	19,095	4.767647	0.216928
Nov	8,230	2.054870	0.093497
Dec	11,326	2.827880	0.128669
Total	400,512	100	4.55

[1] Data for 1992, 1993 and 1994 were not included. From 1992 through 1994, the PVID-MWD Test Fallowing Program was conducted. This reduced the data series to 12 years.

Landowners provided PVID/MWD with the location of the fields they were going to fallow and the date when fallowing would begin. PVID/MWD recorded the information from each landowner into a database, located the fallowed land on maps, and inspected the land to verify the land was fallow on the date indicated by the landowner. This procedure assured appropriate accounting for and verification of the number of fallowed acres.

The number of fallowed acres during each month in calendar year 2014 was determined from the database, resulting in 12 separate time periods during the year (Table 6). The monthly factors, as discussed above, were multiplied by the number of average monthly fallowed acres during the corresponding time period to estimate the corresponding amount of saved water.

Table 6: Estimated Saved Water Using the 12-Year Average Method – Calendar Year 2014

Month	Estimated Irrigation Water Use Factors on Valley Lands (acre-feet/acre)	Monthly Average of Fallowed Lands (water toll acres)	Saved Water (acre-feet)
Jan	0.012031	6,493	78
Feb	0.216860	6,493	1,408
Mar	0.362183	6,493	2,352
Apr	0.512811	6,493	3,330
May	0.621349	6,493	4,034
Jun	0.687160	6,493	4,462
Jul	0.741804	6,493	4,817
Aug	0.615419	12,975	7,985
Sep	0.341291	12,975	4,428
Oct	0.216928	12,975	2,815
Nov	0.093497	12,975	1,213
Dec	0.128669	12,975	1,669
Average for Year		9,194	
Total for Year	4.55		38,591

For example, for the month of January, the average of 6,493 water toll acres was verified to be fallowed under the Program. Based on the 12 years of historical data, 0.264412% of the total annual irrigation water use on Valley lands occurred in January. Multiplying 0.00264412 by 4.55 acre-feet/acre resulted in 0.012031 acre-feet/acre, the average quantity of irrigation water used by each water toll acre during January. Multiplying the average quantity of irrigation water used by each water toll acre in January by the 6,493 water toll acres of fallowed land in January resulted in an estimated water savings for January of 78 acre-feet. This same procedure was applied to the fallowed acreage for all 12 months during calendar year 2014 and resulted in an estimated 38,591 acre-feet of saved water.

6.2 5-Year Average: 1998-2002

The 5-year historical use was based on PVID data for the period 1998 through 2002. The procedure used to calculate the estimated water saved from fallowing Valley lands during calendar year 2014 was the same as that applied in computing the 12-year historical use estimates. The 5-year historical use method yielded an estimated irrigation water use of 4.75 acre-feet/acre and 40,522 acre-feet of saved water during calendar year 2014.

6.3 3-Year Average: 2000-2002

The 3-year historical use method was based on PVID data for the period 2000 through 2002. Following the same procedure as used for the other historical use methods, computations based on the 3-year historical use resulted in an estimated irrigation water use of 5.03 acre-feet/acre and 42,647 acre-feet of saved water during calendar year 2014.

7.0 Actual Use Method – Calendar Year 2014

Under the actual use method, irrigation water use and acreage data from PVID and Reclamation records for calendar year 2014 were used to estimate the amount of saved water. Diversions at the Palo Verde Diversion Dam were reduced by measured returns, unmeasured returns, and deliveries to the Mesa and were used to estimate the amount of irrigation water used by the Valley lands. Based on information provided by PVID, there were a total of 89,107 water toll acres in the Valley portion of PVID that could have received water. Estimated monthly irrigation water use on Valley lands were divided by the average number of water toll acres in production for each month and summed for the 12 months, resulting in an estimated annual irrigation use of 5.13 acre-feet per acre (Table 7).

Table 7: Estimated Irrigation Water Use Factors on Valley Lands – Calendar Year 2014

Month	Diversions Less Measured and Unmeasured Returns (acre-feet)	Deliveries to Mesa (acre-feet)	Estimated Irrigation Water Use on Valley Lands (acre-feet)	Irrigated Valley Lands (water toll acres)	Estimated Irrigation Water Use Factors on Valley Lands (acre-feet/acre)
Jan	7,695	529	7,166	82,614	0.086741
Feb	19,634	748	18,886	82,614	0.228605
Mar	36,211	881	35,330	82,614	0.427651
Apr	49,298	938	48,360	82,614	0.585373
May	63,698	956	62,742	82,614	0.759460
Jun	66,360	988	65,372	82,614	0.791294
Jul	62,985	961	62,024	82,614	0.750769
Aug	34,048	903	33,145	76,132	0.435362
Sep	44,413	947	43,466	76,132	0.570929
Oct	24,441	948	23,493	76,132	0.308582
Nov	10,114	905	9,209	76,132	0.120961
Dec	5,664	908	4,756	76,132	0.062470
Total for Year	424,561	10,612	413,949		5.128197
Yearly Average				79,913	

Source: PVID and Reclamation records.

The same procedure used in Table 6 was followed to develop Table 8. Estimated monthly irrigation water use factors were multiplied by the fallowed acres for each month to estimate the monthly water savings resulting in a total of 43,010 acre-feet of water saved during calendar year 2014.

Table 8: Estimated Saved Water Using the Actual Use Method – Calendar Year 2014

Month	Estimated Irrigation Water Use Factors on Valley Lands (acre-feet/acre)	Monthly Average of Fallowed Lands (water toll acres)	Monthly Saved Water (acre-feet)
Jan	0.086741	6,493	563
Feb	0.228605	6,493	1,484
Mar	0.427651	6,493	2,777
Apr	0.585373	6,493	3,801
May	0.759460	6,493	4,931
Jun	0.791294	6,493	5,138
Jul	0.750769	6,493	4,875
Aug	0.435362	12,975	5,649
Sep	0.570929	12,975	7,408
Oct	0.308582	12,975	4,004
Nov	0.120961	12,975	1,569
Dec	0.062470	12,975	811
Average for year		9,194	
Total for Year	5.128197		43,010

8.0 Conclusions

Two methods were used to estimate the amount of saved water during calendar year 2014: a historical use method and an actual use method. Three historical periods were used covering 12-year, 5-year and 3-year periods. The 12-year historical use method estimated a yearly irrigation water use of 4.55 acre-feet/acre, the 5-year historical use method estimated a yearly irrigation water use of 4.75 acre-feet/acre, and the 3-year historical use method estimated a yearly irrigation water use of 5.03 acre-feet/acre. Compilation of crop and irrigation water use data for calendar year 2014 in PVID resulted in an estimated irrigation use of 5.13 acre-feet/acre. Estimates of saved water for calendar year 2014 are shown in Table 9 and ranged from 38,591 acre-feet to 43,010 acre-feet.

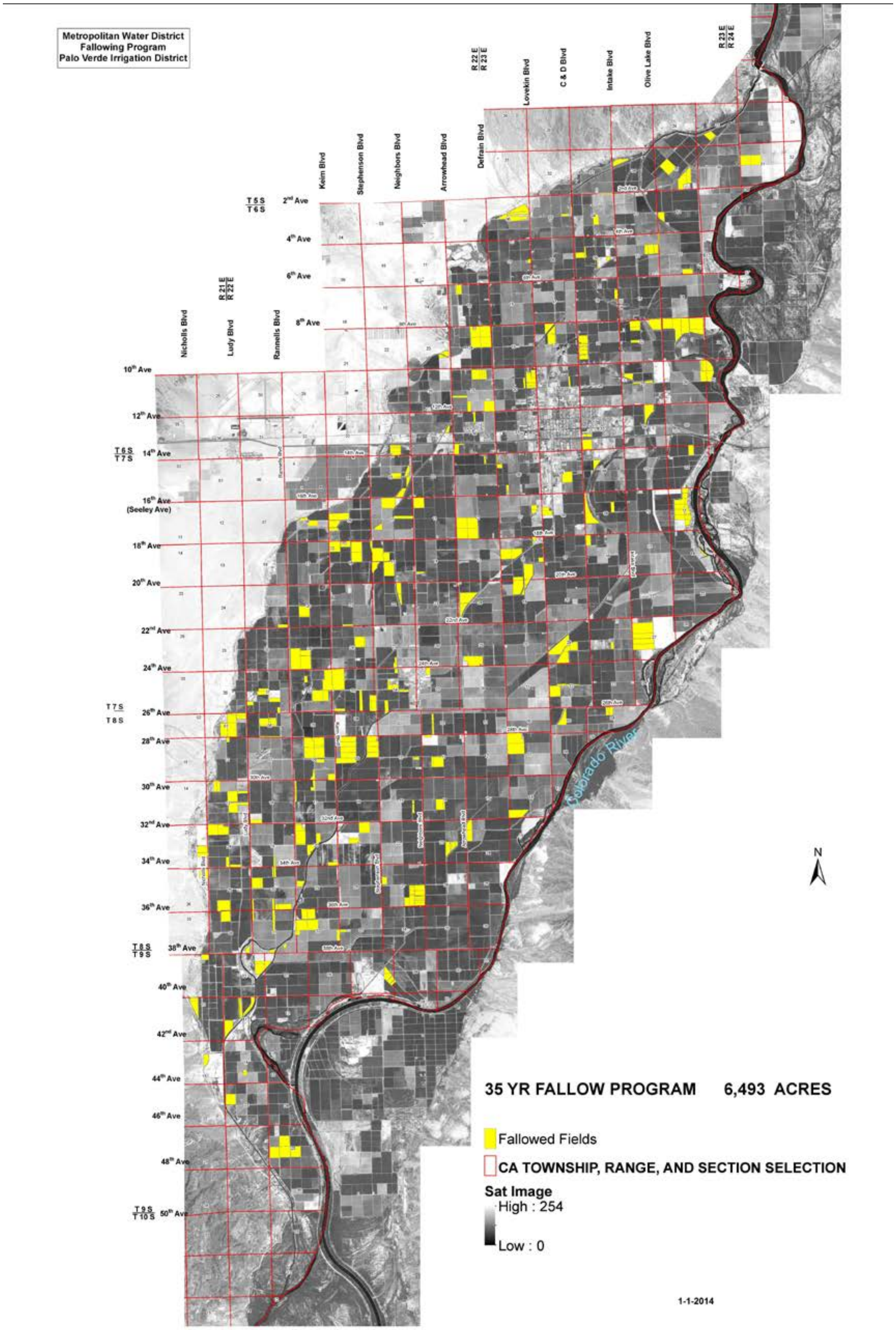
Table 9: Estimates of Saved Water by Method – Calendar Year 2014

Method	Saved Water (acre-feet)
12-Year Average (1988-2002)*	38,591
5- Year Average (1998-2002)	40,522
3- Year Average (2000-2002)	42,647
Actual Use Method - CY 2014	43,010

*1992, 1993 and 1994 data were not included in the analysis. From 1992 through 1994, the PVID-MWD Test Fallowing Program was conducted.

The Actual Use Method is deemed the method most reflective of the agronomic, weather, and market conditions prevailing in the Palo Verde Valley during calendar year 2014. As such, the best estimate of the amount of water saved during calendar year 2014 by the Program is 43,010 acre-feet.

Attachment 1 – Fallowed Fields under the Program on 1/1/2014



Attachment 2 – Fallowed Fields under the Program on 12/31/2014