Prepared for

Jacumba Valley Ranch, LLC
2423 Camino Del Rio South, #212
San Diego, California 92108

JACUMBA VALLEY RANCH PROPERTY WELL #3 AQUIFER TEST REPORT JACUMBA, CA

November 2012

Prepared by

10875 Rancho Bernardo Road, Suite 200
San Diego, California 92127
(858) 674-6559

Geosyntec consultants

engineers | scientists | innovators

Project Number: SC0636

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_____ _____11/27/2012__
Veryl Wittig Date
California Professional Geologist No. 7115
California Certified Hydrogeologist No. 723

Project Number: SC0636

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1. INTRODUCTION

1.1 Terms of Reference

This report was prepared by Geosyntec Consultants, Inc. (Geosyntec) for Jacumba Valley Ranch, LLC (JVR) based on our understanding of the proposed use of groundwater as a source of construction water for the SDG&E East County Substation Project (ECSP). This report documents the activities performed to conduct a 72-hour constant-rate aquifer test on Well #3 on the JVR property (San Diego Assessor's Parcel No. 660-020-05-00; the site) located in Jacumba, California, to evaluate the use of Well #3 as a source of construction water. This report was prepared by Mr. Ryan Gray, PG and has been reviewed by Mr. Veryl Wittig, PG, CHG, in accordance with the peer review policy of the firm.

1.2 Background

It is our understanding that the site production well (Well #3) is proposed for use during construction. The total estimated Project water demand over the 16 month construction period is approximately 153 acre-feet. Construction activities are projected to require pumping at a rate of up to 350 gpm, 24-hours per day for limited periods over a duration of 6 months to meet the peak water demands during grading construction for the East County (ECO) Substation (up to approximately 500,000 gallons per day). Construction water use will increase during the first month of grading activities to the peak demand that will take place over a period of approximately four months. Water use will taper off to approximately 100,000 gallons per day after about 6 months and will continue at a lower rate for the remaining 12 months of the ECSP. This report conservatively evaluates the effect of groundwater pumping at the peak rate continuously 24 hours per day for a period of 6 months (approximately 276 acre-feet, which exceeds the anticipated total Project demand).

1.3 Site Location

The site is located in southeastern San Diego County in the community of Jacumba, approximately 74 miles east of San Diego (Figure 1). The area immediately surrounding the site consists of open, native land, agricultural, and rural residential properties. The site has historically been used for agricultural purposes, though current operations consist of an aggregate washing facility in the northeastern portion of the site.

Numerous wells exist on the large parcels which comprise the site. The following 4 wells were selected for the constant-rate aquifer test based on their anticipated yield and accessibility (Figure 2): Well #3 (pumping well), Daley Well (observation well; approximately 60 feet north), Mid-Valley Well (observation well; approximately 0.6 miles south), and Well #2 (observation well; approximately 0.85 miles south). Due to the age of the agricultural wells onsite, construction details were only available for Well #3.

This production well was constructed with 14-inch steel casing to a total depth of 100 feet below ground surface (ft bgs), with a 60 foot screened interval reaching the total depth of the well. Based on the total depths measured in the observation wells (Table 1) it is assumed that all wells are hydraulically connected to the unconfined alluvial aquifer within which Well #3 is screened. It is our understanding that no domestic supply water wells (not owned or operated by JVR) exist within 0.5 miles of the groundwater production well proposed for use during construction.

1.4 Objectives

The objectives of the work described herein were to provide JVR with the professional services necessary to prepare a groundwater study to assess the existing condition and proposed use of the underlying groundwater/aquifer and all existing onsite wells (with owner's permission). The objectives of the groundwater study are to:

- Evaluate aquifer properties and aquifer storage;
- Estimate short- and long-term well water supplies from the proposed pumping well;
- Document the proposed pumping well (Well #3) is capable of producing the total amount of water to be supplied for construction;
- Estimate of short- and long-term impacts from the use of Well #3 on local groundwater production (short-term extraction for construction water and ongoing O&M water), and on other wells in the Project area; and
- Assess the potential for subsidence brought on by Project-related water use in the area.

To achieve the project objectives, Geosyntec performed the following scope of work:

- Performed ambient groundwater monitoring;
- Conducted a 72-hour constant-rate aquifer test;
- Performed analysis of aquifer test data; and
- Prepared this Report.

2. GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

2.1 General

The site lies in the Jacumba Valley Groundwater Basin (Basin Number 7-47) located in the southeastern Peninsular Ranges. The average annual rainfall for this area ranges from approximately 14 to 16 inches, with main water bearing deposits located in the alluvium and the Table Mountain Formation (DWR, 2004).

The Holocene alluvium is an unconfined aquifer consisting mostly of gravel, sand, and clay, which are estimated to range from 100 feet to 150 feet thick. Wells completed in these deposits can reportedly produce more than 1,000 gpm with a specific yield estimated to range from 5% up to 25% (DWR, 2004).

The Table Mountain Formation is Tertiary age and consists of medium- to coarse-grained sandstone and conglomerate that unconformably overlies crystalline basement rocks (DWR, 2004). This unit lies below and is separated from the Holocene alluvium by Tertiary age Jacumba volcanics, which creates semi-confined to confined conditions in the lower aquifer (DWR, 2004). The Table Mountain Formation is estimated to be up to 600 feet thick with a specific yield estimated to range from 5% to 10% (DWR, 2004).

Numerous studies indicate the groundwater in storage in the alluvial aquifer ranges from approximately 3,200 to 16,000 acre/feet (DWR, 2004). Groundwater storage in the Table Mountain Formation aquifer has been estimated to range from 84,000 to 169,000 acre/feet (DWR, 2004). In 2009, the County of San Diego, Department of Planning and Land Use (DPLU), prepared a County wide General Plan Update Report which estimated the basin wide storage to be approximately 32,600 acre-feet throughout the approximate 16,000 acres which comprise the basin (DPLU, 2009).

The Jacumba Valley Groundwater Basin is be recharged through infiltration of water from the Boundary Creek and Flat Creek drainages (DWR, 2004). Recharge has been estimated to range from approximately 1,456 acre-feet per year (DPLU, 2009) to 2,700 acre-feet per year (DWR, 2004). Groundwater usage within the basin has been estimated to be 165 acre-feet per year (DPLU, 2009). Based on these data and current conditions, which are substantially similar to those present during the cited studies, the rate of recharge to the Jacumba Valley Groundwater Basin exceeds the use.

2.2 Groundwater Elevations and Flow Direction

Groundwater levels were measured in each groundwater well prior to transducer deployment on 6 November 2012 (Table 1). The depth to groundwater in supply wells at the site ranged from 41.44 ft bgs in the Daley Well to 60.24 ft bgs in Well #2. Based on pre-aquifer test groundwater elevations, groundwater flow beneath the site is estimated to be northerly, with a hydraulic gradient ranging from approximately 0.001 to 0.005 feet per foot (ft/ft) (Figure 2).

3. AQUIFER TESTING AND ANALYSIS

3.1 Constant-Rate Discharge Test

From 6 November to 10 November 2012, a constant-rate aquifer test was performed to address the aquifer test objectives. The aquifer test consisted of an ambient phase, pumping phase, and recovery phase. Data obtained from the constant-rate aquifer test are provided electronically in Appendix A. The following procedures for each phase of data collection were used during the constant-rate discharge test.

3.1.1 Ambient Phase

Prior to the start of the pumping test, Geosyntec deployed pressure transducers in the Daley Well and the Mid-Valley Well and measured each well's total depth and depth to groundwater (Table 1). After synchronizing each transducer and confirming the transducers were recording correctly, collection of ambient groundwater level data was performed for an approximate 24-hour period.

Current groundwater uses at the site consist of pumping from Well #3 at approximately 450 gpm for 8 to 10 hours per day, 5 days per week. Pumping in Well #3 was halted 4 days prior to commencing the ambient monitoring phase.

Data collection during the ambient monitoring phase was performed at 10 minute (linear) at the two closest observation wells (Daley Well and Mid-Valley Well). Manual water level measurements were collected at the start and end of the ambient data collection phase and transducer data was downloaded prior to the start of the pumping phase of the test. Manual water level measurements were also obtained in Well #2, where no transducer was deployed. Ambient monitoring of the pumping well (Well #3) was not performed because of ongoing modifications to the depth and configuration of the sounding tube at this location. Based on the proximity to the nearest observation well (Daley well, 60 ft north) it is believed that data from this location were representative of pre-pumping conditions in the vicinity of Well #3.

3.1.2 Pumping Phase

At the conclusion of the ambient monitoring period, Geosyntec deployed a pressure transducer in Well #3, and each transducer was synchronized and re-programmed to begin data collection a few seconds prior to the start of the pump test as follows:

- Pumping well (Well #3): Logarithmic data collection.
- Observation wells (Daley Well and Mid-Valley Well): Linear data collection (10 minute intervals).

During the operation of the constant-rate pumping test, manual measurement of the water levels in the observation wells (including Well #2) were performed at regular intervals and the discharge rates were frequently recorded. Minor adjustments to the pump discharge rate were made to maintain a relatively consistent target discharge rate of 350 gpm.

3.1.3 Recovery Phase

At the end of the 72-hour pumping period final manual water level measurements were obtained and data from each transducer was downloaded. Prior to pump shutdown each transducer was synchronized and re-programmed to begin data collection a few seconds prior to the end the pumping phase as follows:

- Pumping well: Logarithmic data collection.
- Observation wells: Linear data collection.
    - Daley Well: 5 minute intervals at the Daley well.
    - Mid-Valley Well: 10 minute intervals.

Manual measurements consistent with the frequencies performed during the pumping phase were conducted until adequate recovery data was collected from each location where drawdown was observed.

3.2 Analysis of Aquifer Test Data

3.2.1 Observed and Projected Drawdown

At the conclusion of the pumping test, measured levels of drawdown ranged from 4.07 feet in the Daley well (northern observation well) to 7.30 feet in Well #3 (pumping well). No groundwater elevation changes outside of diurnal variations were observed in either of the southern observation wells, indicating that the 72-hour aquifer test had no influence on wells outside of 0.5 miles from the pumping well. Following review of the 72-hour drawdown data, the projected 6-month drawdown for the Daley Well and Well #3 are estimated to range from approximately 9 feet to 12 feet, respectively (Figure 3).

Therefore, based on the static groundwater depth in Well #3 (approximately 42 ft bgs), the projected drawdown after 6 months of pumping at a continuous rate of 350 gpm (12 feet), and the reported pump inlet depth (approximately 86 ft bgs) the groundwater depth at 6 months of operation is estimated to be 54 ft bgs. Taking into account the maximum range of historical seasonal groundwater fluctuations (approximately 17 ft; Appendix B) in this area [DPLU, 2009], the total depth to groundwater in Well #3 could reach a levels of 71 ft bgs. Therefore, the available data indicates that Well #3 is capable of providing both short- and long-term water resources for Project construction.

A summary of the 72-hour observed and 6-month projected drawdowns are provided in Table 2. A graphical representation of the drawdown data obtained from Well #3 and the Daley Well, along with their respective 6-month projected drawdowns are provided on Figure 3.

3.2.2 Aquifer Properties

Drawdown data collected from the Daley Well and recovery data collected from Well #3 were analyzed using Aqtesolv™ software to calculate the aquifer transmissivity (T) and hydraulic conductivity (K) in the vicinity of the pumping well (Appendix C, Figures C-1 and C-2). Results of drawdown data analysis in the Daley Well using the Cooper-Jacob method estimated a transmissivity value of approximately 8,779 square feet per day (ft^2/day). Results of recovery data analysis in Well #3 using the Theis Approximation method estimated a transmissivity of 12,950 ft^2/day. These results were calculated using an aquifer thickness equivalent to 58 ft. (the saturated thickness of the screened interval of Well #3 at the start of testing), these transmissivity values equate to hydraulic conductivity (K = T/b) values ranging from approximately 151 feet per day (ft/day) to 223 ft/day, respectively.

Storage in the alluvial aquifer has been estimated to range from 3,200 acre-feet to 16,000 acre-feet (DWR, 2004). Based on the estimated current domestic demand [165 acre-feet per year (DPLU, 2009)], estimated minimal annual basin recharge of approximately 1,456 acre-feet per year (DPLU, 2009), and the projected peak temporary 6-month project demand (276 acre-feet), adequate water storage in the alluvial aquifer is available to meet existing demand and temporary project construction needs without adversely affecting the aquifer conditions in the short- or long-term.

Specific yield was estimated using the late-time drawdown data in the Cooper-Jacob Method (Figure B-3). A specific yield of 0.2349 (23.49 percent) was estimated from the Daley Well drawdown data, consistent with previously calculated values for the alluvial aquifer (DWR, 2004).

3.3 Aquifer Impact Analysis

Based on the aquifer test data and the 6-month projected drawdown data, Well #3 is a viable source for providing the projected water quantities for the 6-month project during construction. Using the projected 6-month drawdown data from Well #3 and the Daley Well (Figure 2), the estimated extent of the 6-month cone of depression resulting from the Project's temporary groundwater pumping activities was plotted (Figure 4).

Based on the projected aquifer drawdown, the temporary drawdown in the alluvial aquifer resulting from pumping to support the maximum construction water use rate over 6 months is expected to be limited to an area less than 300 feet surrounding the Well #3.

The limited extent of anticipated temporary drawdown and the absence of private domestic wells (not under the control of JVR) within this radius indicate that no permanent impacts to the aquifer or adverse effects to offsite domestic supply wells are anticipated to result during the proposed groundwater pumping activities.

Furthermore, the range of drawdown expected occur during the duration of Project activities (approximately 9.0 to 12.0 ft), are within the reported range of historical seasonal groundwater fluctuations in the Jacumba area [DPLU, 2009]. Therefore, pumping activities associated with the project are not expected to promote subsidence outside of any normal ranges that may occur in this area due to seasonal water level fluctuations.

4. SUMMARY AND CONCLUSIONS

4.1 Aquifer Testing

Drawdown data collected from the Daley Well and recovery data collected from Well #3 were analyzed using Aqtesolv™ software to calculate the aquifer transmissivity (T) and hydraulic conductivity (K) in the vicinity of the pumping well (Figures C-1 and C-2). Results of data analysis estimated transmissivity values of ranging from approximately 8,779 ft^2/day in the Daley Well to 12,950 ft^2/day in Well #3. These transmissivity values equate to hydraulic conductivity values of approximately 151 feet per day (ft/day) and 223 ft/day, respectively. A specific yield of 0.2349 (23.49 %) was estimated using the late time data in the Cooper-Jacob Method (Figure C-3).

The most recent study for the Jacumba Valley Groundwater Basin estimates groundwater in storage to be approximately 32,600 acre-feet (DPLU, 2009), though studies specific to the alluvial aquifer have estimated groundwater in storage to range from 3,200 acre-feet to 16,000 acre-feet (DWR, 2004), with an estimated minimum recharge of 1,456 acre-feet per year (DPLU, 2009). Based on these data and the estimated cumulative demand during project activities (165 acre-feet per year existing demand and projected 276 acre-feet temporary maximum project demand), there is adequate water storage and recharge in the alluvial aquifer to meet existing demand and temporary project construction needs without adversely affecting the aquifer conditions in the short- or long-term.

4.2 Aquifer Impact Analysis

Based on the data collected during the 72-hour constant-rate aquifer test at JVR production Well #3 and the apparent surplus of groundwater storage, the current pump configuration and aquifer conditions are adequate to support the proposed volume (276-acre-feet), extraction rate (350 gpm), and duration of maximum water use required by the Project (6 months). Following the short period of maximum water demand, lower volumes will be required (approximately 100,000 gallons per day) for Project related activities. These reduced volumes will lessen the horizontal and vertical limits of aquifer drawdown for Project activities to levels similar to those induced by JVRs current operations. Therefore, the groundwater pumping activities are not anticipated to cause adverse short- or long-term impacts to the aquifer, or nearby (within 0.5 miles) supply wells for the duration of the Project. Furthermore, the drawdown induced during the 6-months of maximum demand for Project construction is within reported historical seasonal groundwater fluctuations for the Jacumba area, and is not expected to induce subsidence outside of any normal occurrences.

5. RECOMMENDATIONS

This report documents the procedures and results of the 72-hour constant-rate aquifer test performed on Well #3 at the site located in Jacumba, California. The available data indicate that current pump and aquifer conditions are capable of supplying sufficient water and no adverse effects to the aquifer or surrounding supply wells are anticipated to result from the proposed pumping activities. Routine (monthly) monitoring of groundwater levels is recommended during project construction to document water levels in the accessible wells on the JVR property and monitor variations attributable to pumping in support of Project construction and seasonal groundwater fluctuation.

6. REFERENCES

DPLU (Department of Planning and Land Use), 2009. *County of San Diego Department of Planning and Land Use General Plan Update Groundwater Study, Figure 2-58*. May 18, 2009.

DWR (Department of Water Resources). 2004. *Hydrologic Region Colorado River, Jacumba Valley Groundwater Basin; California's Groundwater Bulletin 118.* February 27, 2004. Accessed 14 November 2012, at: http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/7-47.pdf

TABLES

Table 1
Summary of Static Groundwater Depths and Well Characteristics
Jacumba Valley Ranch Property
Jacumba, California

Geosyntec consultants

Well	Gauging Date	Approximate Elevation (ft msl)	Height of Reference Point (ft above ground)	Depth to Water (ft toc)	Depth to Water (ft bgs)	Approximate Groundwater Elevation (ft msl)	Total Depth (ft bgs)	Pump Inlet Depth (ft bgs)
Well #3	11/6/2012	2765	2.33[1]	44.24	41.91	2,723.09	100[2]	86.00
Daley Well	11/6/2012	2765	2.21	43.65	41.44	2,723.56	147.99	NA
Mid-Valley Well	11/6/2012	2789	1.71	52.73	51.02	2,737.98	89.99	NA
Well #2	11/6/2012	2800	1.46	61.70	60.24	2,739.76	112.77	NA

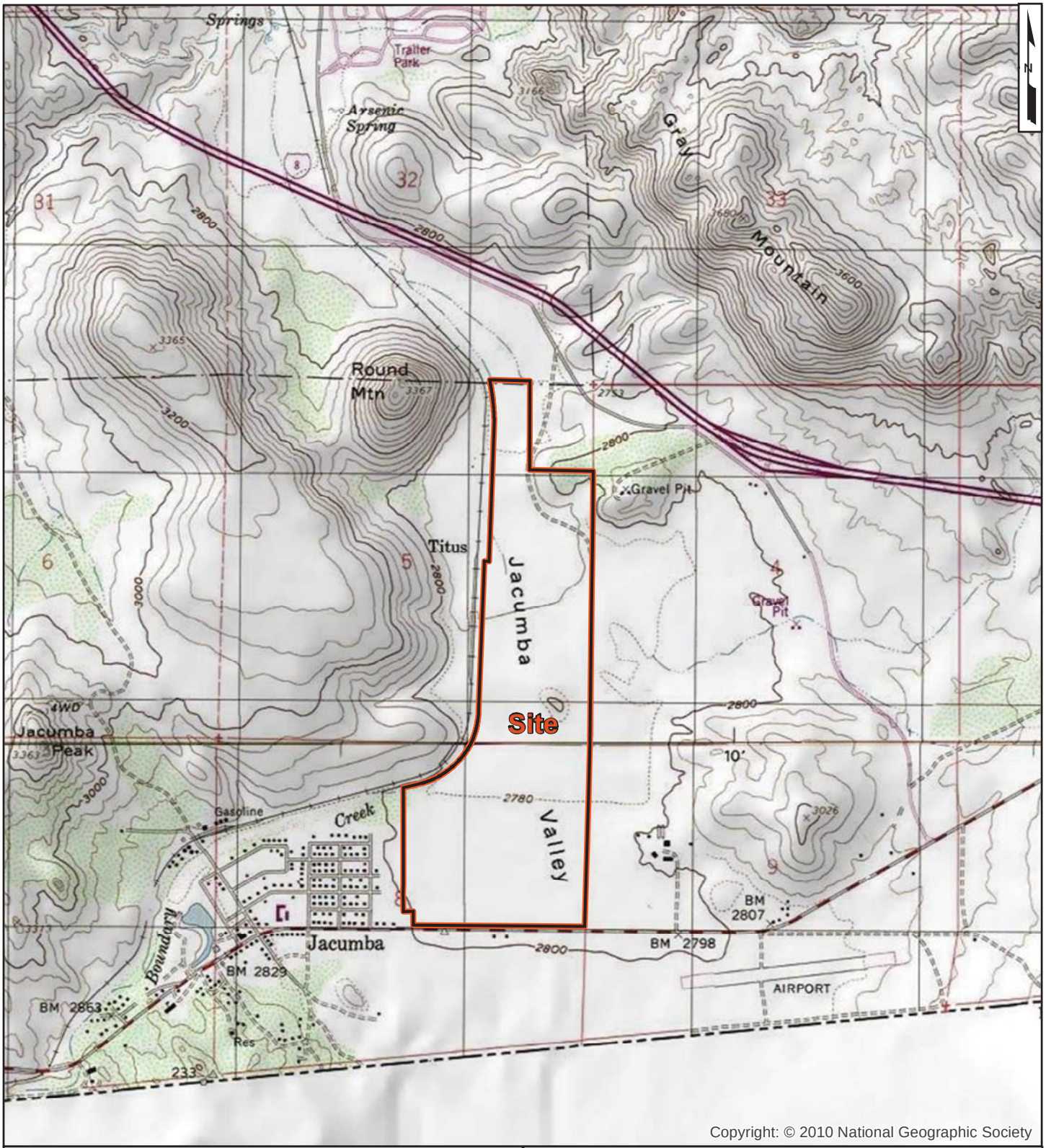
Notes:
1 - Measured before modifications to sounding tube.
2 - Obtained from construction log (Appendix A).
ft msl - feet above mean sea level (estimated based on online resources).
ft - feet
ft bgs - feet below ground surface
ft toc - feet below top of casing
NA - Not Applicable

Geosyntec consultants

Table 2
Summary of Observed and Projected Drawdown Data
Jacumba Valley Ranch Property
Jacumba, California

Constant Rate Discharge Test				
Parameter	**Pumping Well**	**Observation Well**		
	Well #3*	**Daley Well**	**Mid-Valley Well**	**Well #2**
Maximum Drawdown (ft) (72-Hours)	7.3	4.07	0	0
Projected Drawdown (ft) (6-Months)	12	9	0	0
Approx. Distance From Pumping Well	0	60 feet	0.6 Miles	0.85 Miles

FIGURES



2,000 1,000 0 2,000 Feet

Site Vicinity and Location Map

Jacumba Valley Ranch Property
Jacumba, California

Geosyntec consultants

San Diego	November 2012	Figure 1

Document Path: P:\GIS\ECO\JVR_SiteMap.mxd

600 300 0 600 Feet

Legend

- Groundwater Monitor Well (Groundwater Elevation in Feet Above Mean Sea Level)
- 2738 — Groundwater Elevation Countour (Contour Interval = 2 ft)
- 0.005 — Approximate Groundwater Flow Direction and Hydraulic Gradient (ft/ft)
- Approximate Property Boundary

Groundwater Elevations and Flow Direction, 6 November 2012

Jacumba Valley Ranch Property
Jacumba, California

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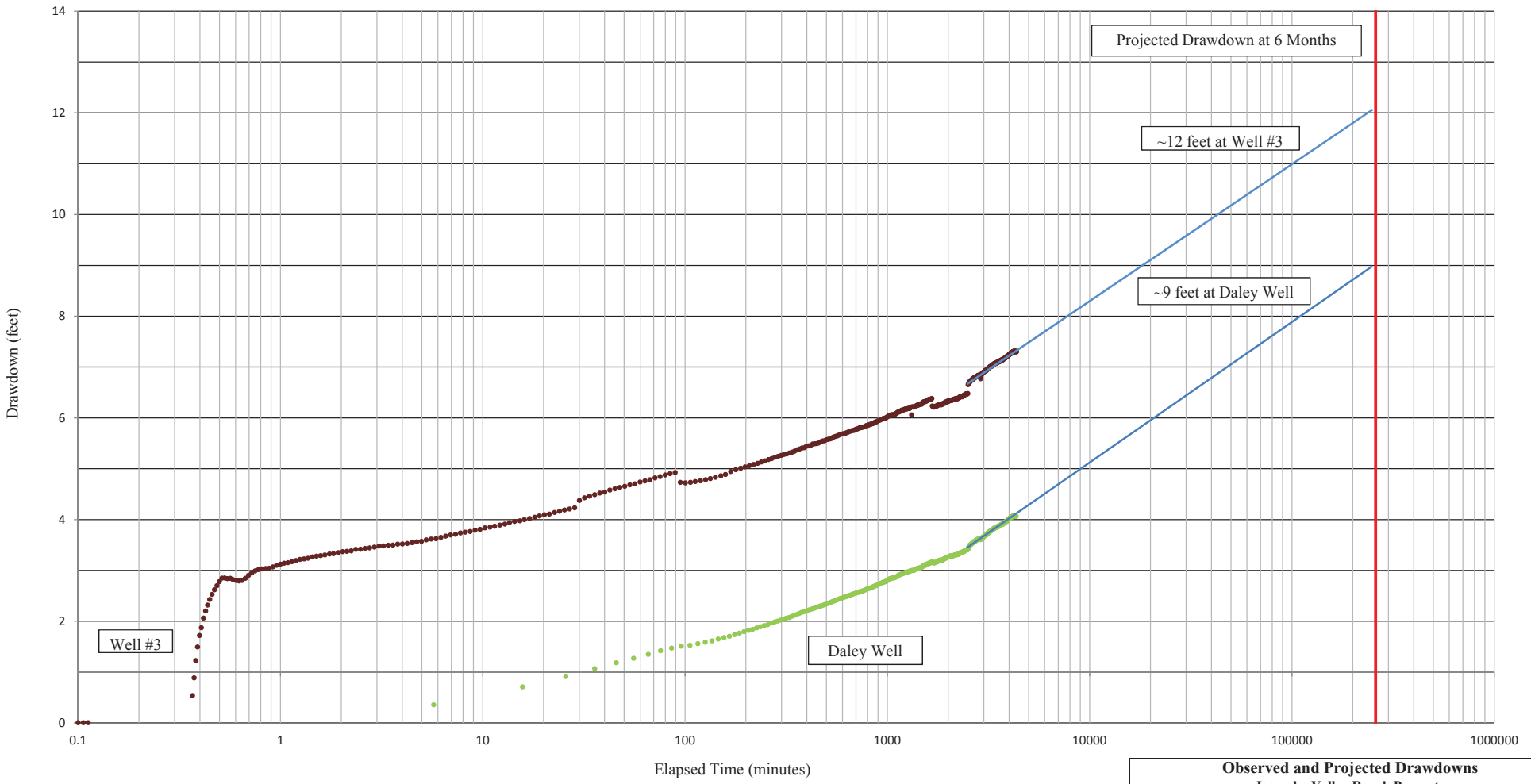
Figure 2



Observed and Projected Drawdowns
Jacumba Valley Ranch Property
Jacumba, California

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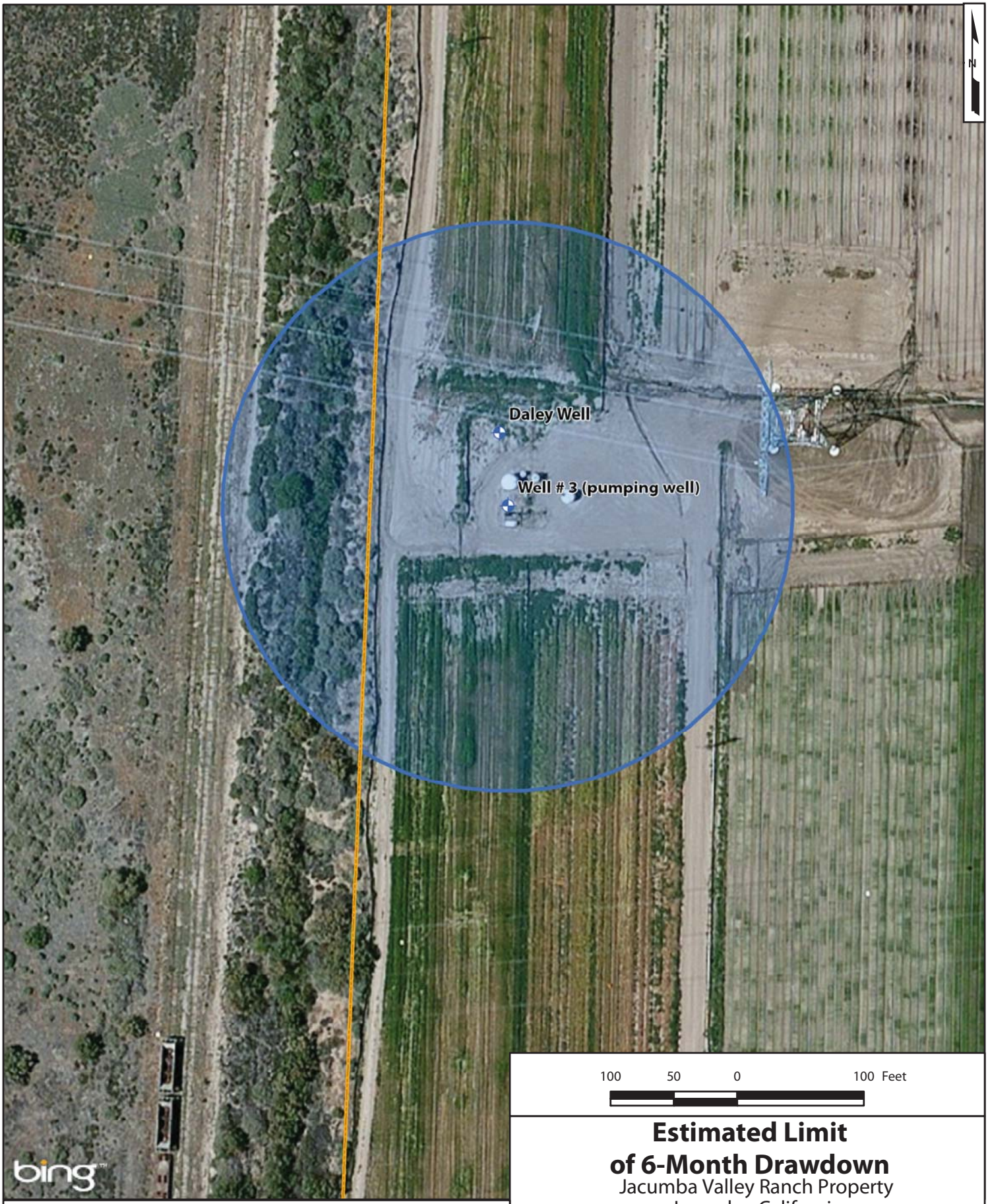
Figure 3



100 50 0 100 Feet

Estimated Limit of 6-Month Drawdown

Jacumba Valley Ranch Property
Jacumba, California

Legend

- Groundwater Well
- Estimated Limit of Projected Groundwater Drawdown
- Site Boundary

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Figure 4

APPENDIX A

Constant-Rate Aquifer Test Data

APPENDIX B

DPLU GP Update Report Excerpts

Table C-37
Jacumba Valley Basin
Groundwater in Storage Calculations

600 Units were not on GP Update Map for Specific Plan Area - Included additional 300 afy manually in the calculations

Size (Acres)	16039
Modeled Maximum GW in Storage (AF)	32601
Modeled Average GW Recharge (AFY)	1456

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	165	100%	99%
Current General Plan Buildout	2295	54%	1%
Referral Map Buildout	1259	91%	74%
Draft Land Use Map Buildout	1258	91%	74%
Hybrid Map Buildout	1258	91%	74%
Environmentally Superior Buildout	1008	93%	81%
Cumulative Impacts Buildout	1258	91%	74%

Note: Future predicted change in the amount of groundwater in storage for scenarios is based upon historical precipitation from July 1971 to June 2005. Scenarios with estimated groundwater in storage at or below 50% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

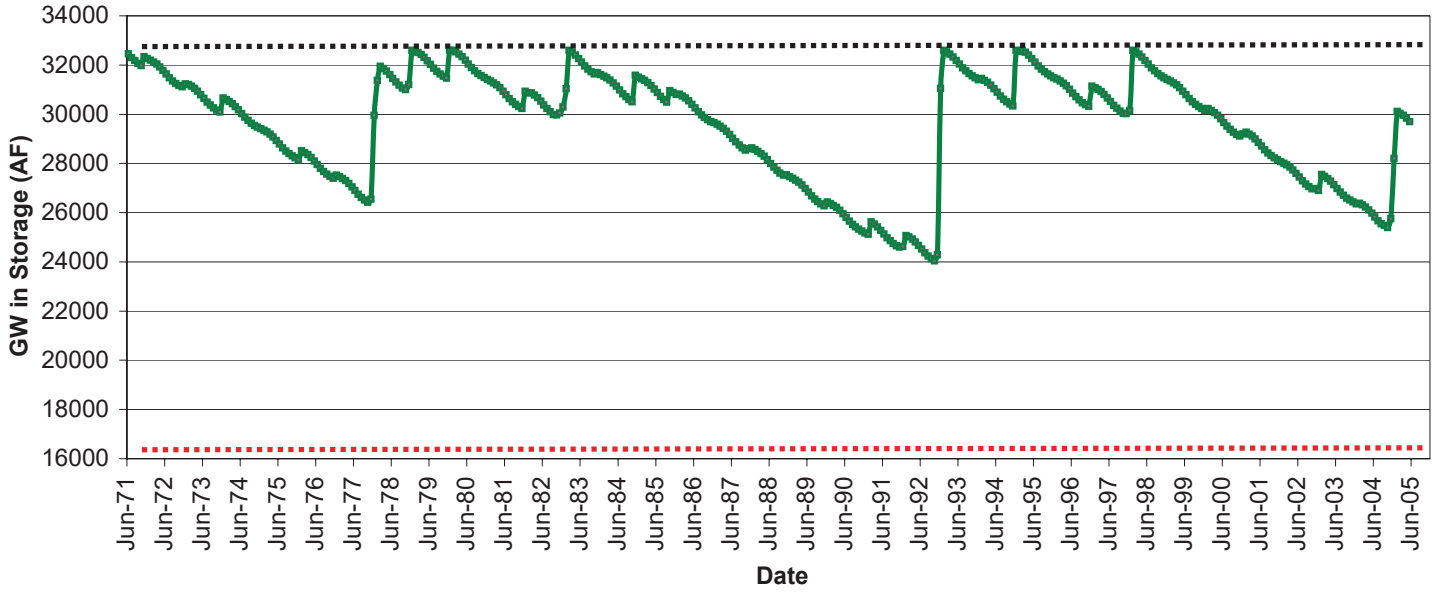
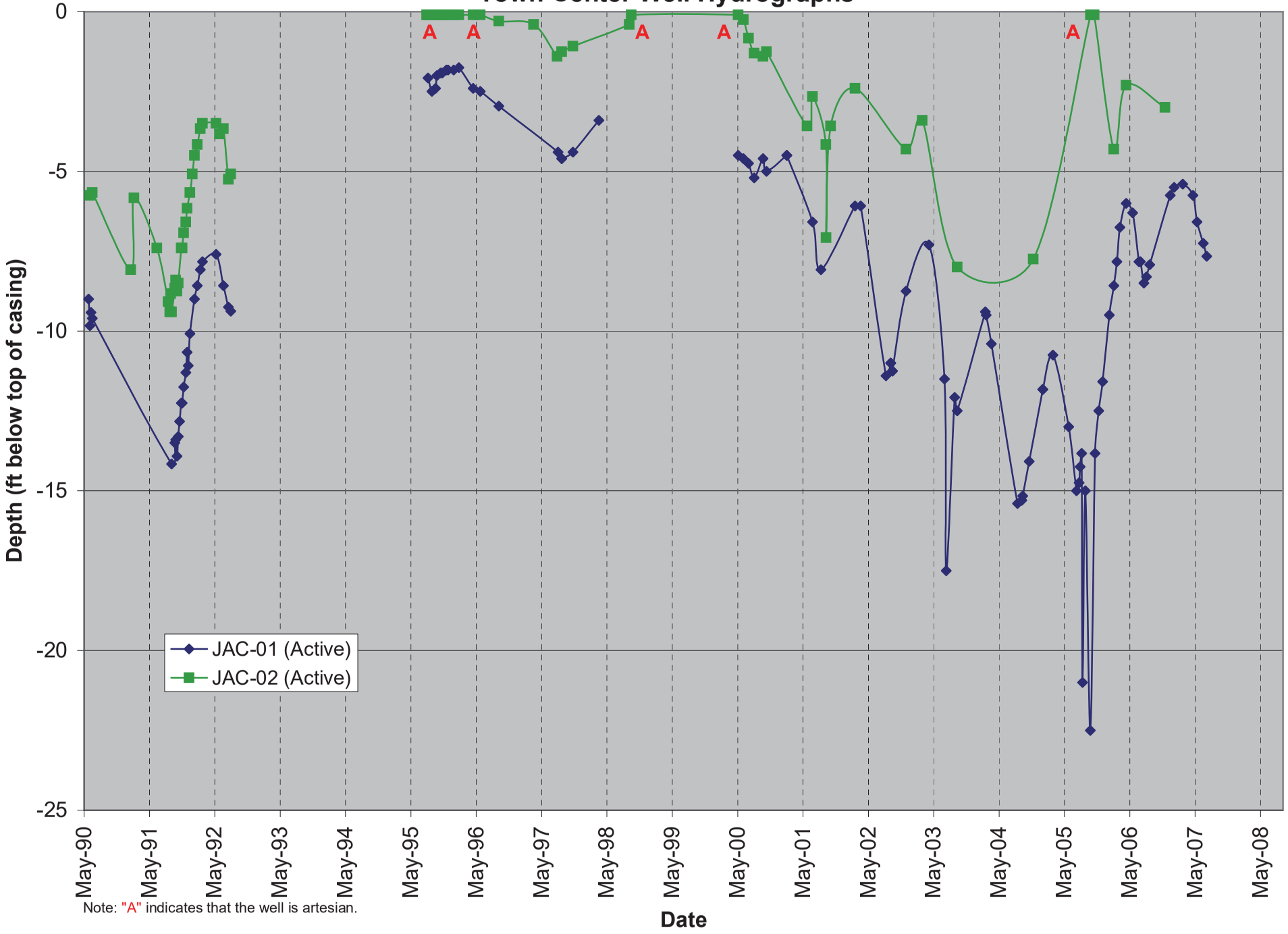


Figure 2-58: Jacumba Community Sponsor Group Town Center Well Hydrographs



Note: "A" indicates that the well is artesian.

APPENDIX C

Aqtesolv™ Output Reports

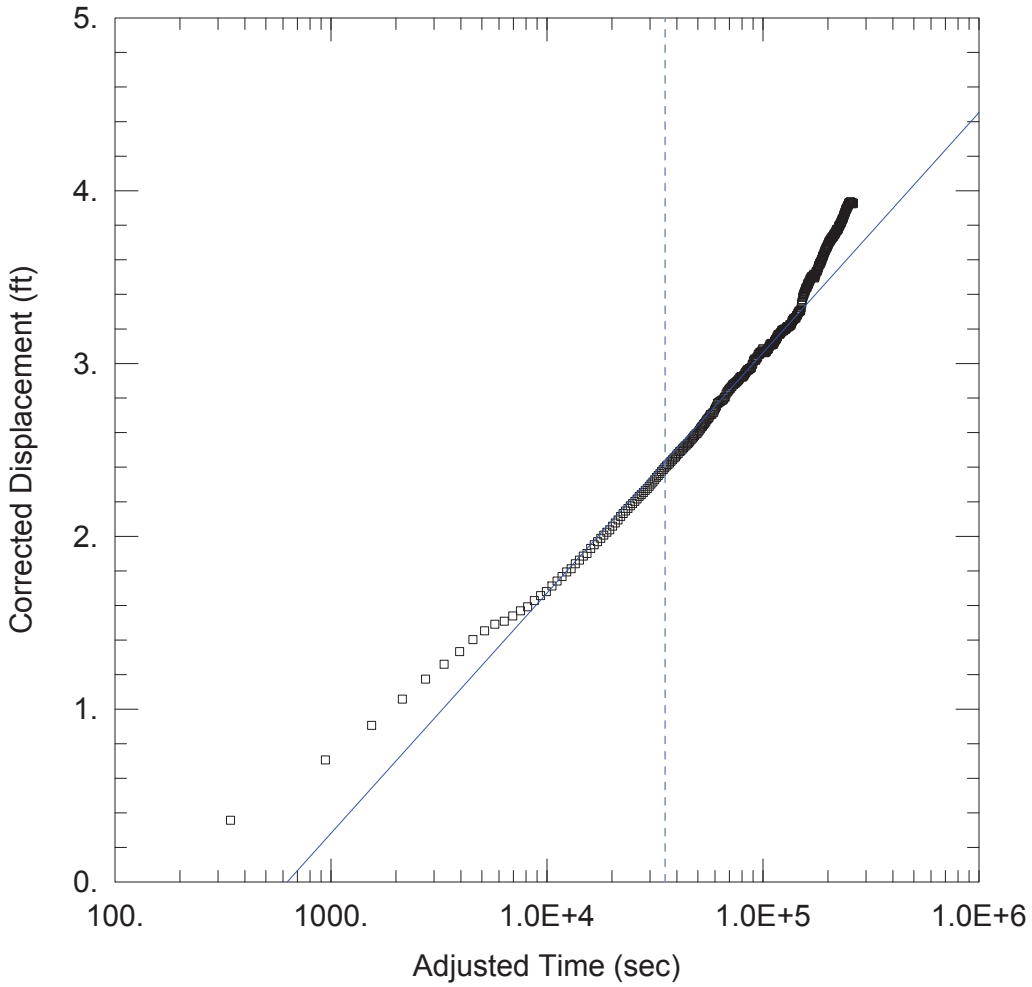


FIGURE C-1

Data Set: Q:\SC0636 JVR Aquifer Test\AQTESOLV\Daley Well.Drawdown.Figure C-1.aqt
Date: 11/21/12 Time: 10:35:10

PROJECT INFORMATION

Company: Geosyntec Consultants
Client: JVR
Project: SC0636
Location: Jacumba
Test Well: Well #3
Test Date: 11/7/2012

AQUIFER DATA

Saturated Thickness: 58. ft Anisotropy Ratio (Kz/Kr): 1.174E-5

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well #3	0	0
Daley Well	60	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ Daley Well	60	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 8778.5 ft^2/day S = 0.03976

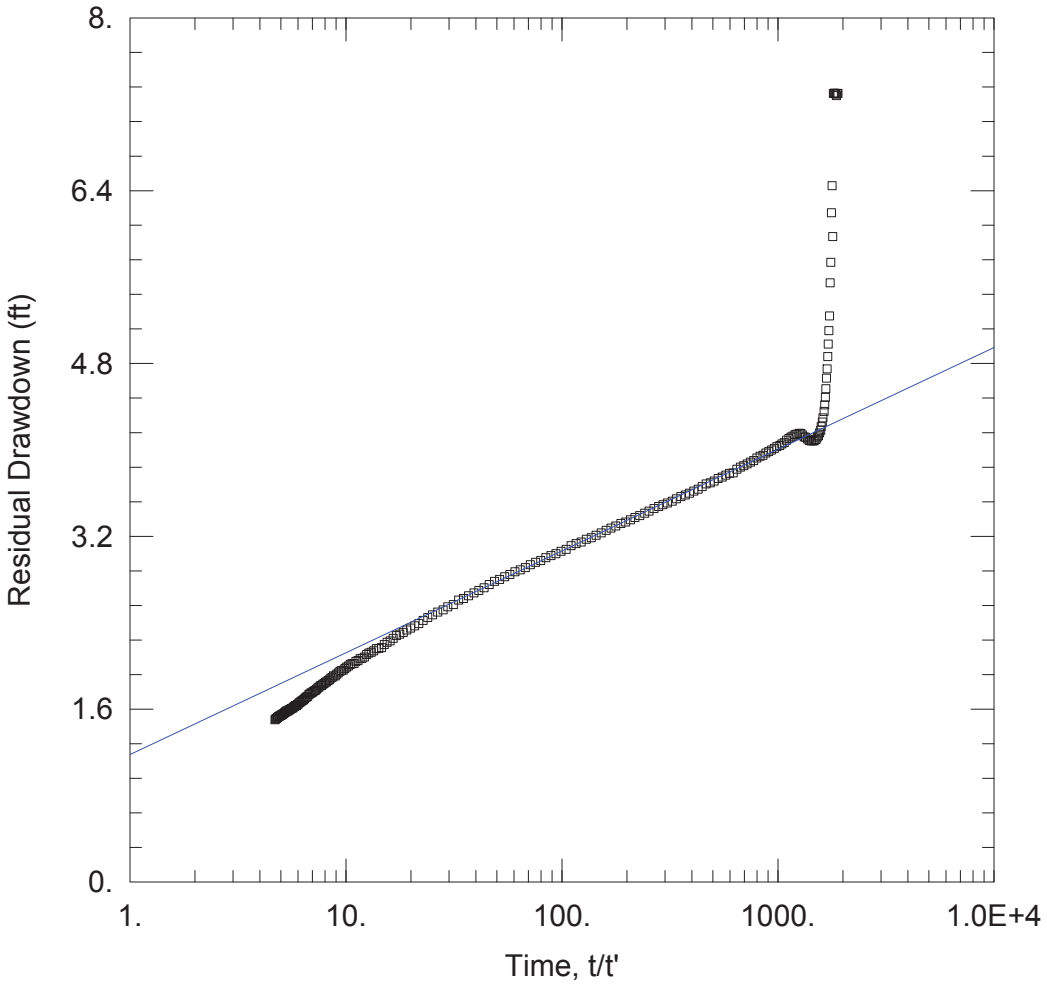


FIGURE C-2

Data Set: Q:\SC0636 JVR Aquifer Test\AQTESOLV\Well#3.Figure C-2.aqt
Date: 11/21/12 Time: 10:28:57

PROJECT INFORMATION

Company: Geosyntec Consultants
Client: JVR
Project: SC0636
Location: Jacumba
Test Well: Well #3
Test Date: 11/7/2012

AQUIFER DATA

Saturated Thickness: 58. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well #3	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ Well #3	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 1.295E+4 ft^2/day S/S' = 0.05601

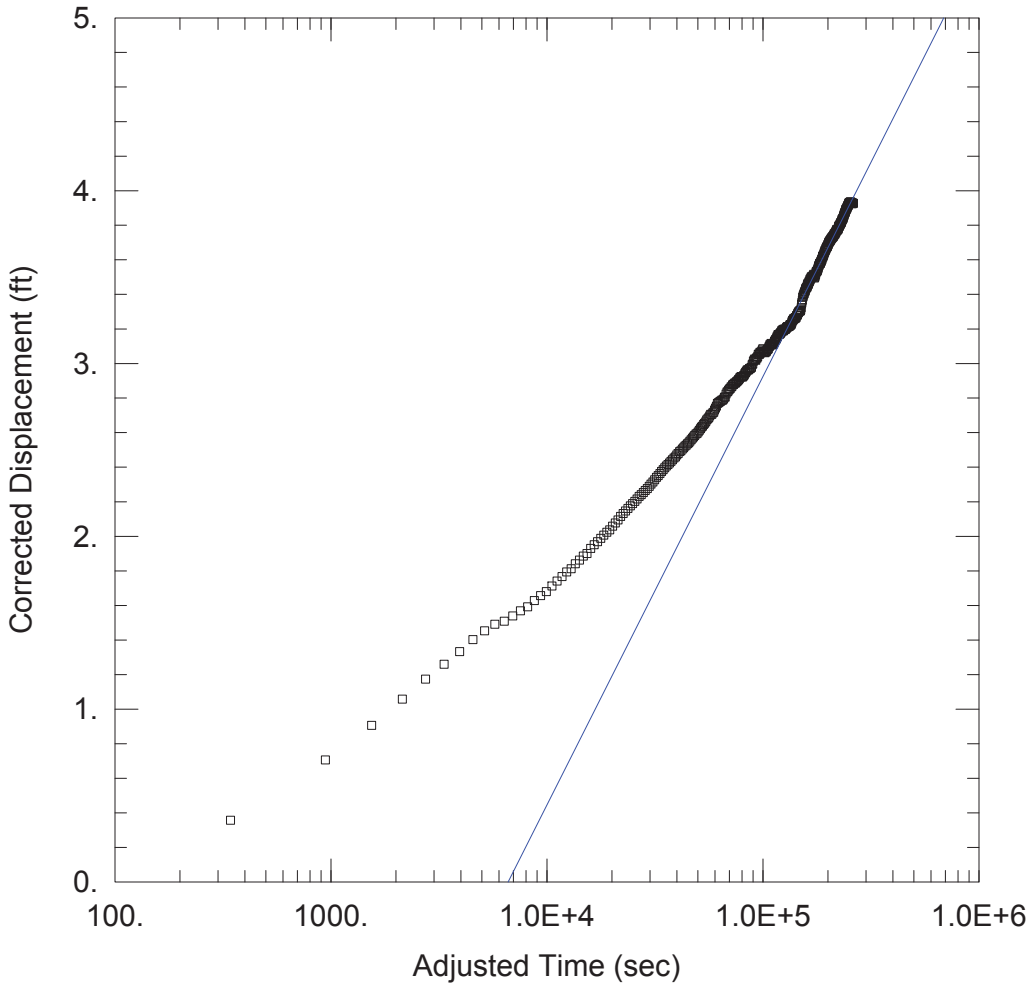


FIGURE C-3

Data Set: Q:\SC0636 JVR Aquifer Test\AQTESOLV\Daley Well.Drawdown.Figure C-3.aqt
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PROJECT INFORMATION

Company: Geosyntec Consultants
Client: JVR
Project: SC0636
Location: Jacumba
Test Well: Well #3
Test Date: 11/7/2012

AQUIFER DATA

Saturated Thickness: 58. ft Anisotropy Ratio (Kz/Kr): 1.174E-5

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
Well #3	0	0
Daley Well	60	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ Daley Well	60	0

SOLUTION

Aquifer Model: Unconfined Solution Method: Cooper-Jacob

T = 4923.3 ft^2/day S = 0.2349