Final - Groundwater Investigation of the 112.6-acre Freedom Ranch Facility located on Buckman Springs Road, San Diego County, California

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

afy – acre-feet per year

APN – Assessor’s parcel number

bgs – below ground surface

CEQA – California Environmental Quality Act

CIMIS – California Irrigation Management Information System

DEH – San Diego County Department of Environmental Health

ET – evapotranspiration

ETo – reference evapotranspiration

GP – general plan

MCL – maximum contaminant level

mg/L – milligram per liter

msl – mean sea level

MUP – Major Use Permit

pCi/L – picocuries per liter

PET – potential evapotranspiration

TDS – total dissolved solids

EXECUTIVE SUMMARY

AECOM conducted a limited groundwater investigation of the 112.6-acre Freedom Ranch Facility located adjacent to Buckman Springs Road in the unincorporated area of Campo, in south central San Diego County, California. Currently, the Freedom Ranch is a 50-bed men's residential alcohol and drug treatment and recovery facility. The project proposes to modify the existing major use permit (MUP) to expand the facility in phases from 50 to 125 beds. Proposed buildings include a multi-purpose building, five dormitories, two parking lots, improved driveways, and new septic systems. Water for the facility is currently and will be in the future supplied by one onsite well (Well-12) regulated by the San Diego County Department of Environmental Health (DEH) as part of a State of California Small Drinking Water System. Wastewater will continue to be disposed by existing and new septic systems. The project site is near the southern end of a roughly 1,940-acre basin. There are a few dozen well users within the basin. Based on direction from the County Groundwater Geologist, water quality sampling was not included in the scope of work for this project. Based on the results of our 30-year water balance groundwater quantity is not anticipated to be a significant impact for the project.

1.0 INTRODUCTION

1.1 Purpose of the Report

The purpose of this report is to determine if sufficient groundwater exists in the basin surrounding the subject property to support modifying the major use permit (MUP) from a 50-bed residential facility to 125 beds at maximum buildout within the basin.

1.2 Project Location and Description

The approximately 112.6-acre property (assessor's parcel numbers [APN]s: 607-110-10, 11, 36 and 52, 607-120-68), is located along Buckman Springs Road, near the intersection of Phelps Road, about 1½ miles northwest of Cameron Corners, in the unincorporated area of Campo, in south central San Diego County, California (Figure 1). The actual footprint of operations is approximately 24 acres. The project proposes increasing the number of licensed recovery home beds from 50 to 125 and providing a dining hall for 150 patrons. There are eight wells on the property; two wells (Well-12 and Well-B) are outfitted with submersible pumps and capable of providing potable water. Well-B, located in a well shed near the southern property boundary, is no longer used for the facility operations. Well-12, located near the northern property boundary, is the primary potable water supply for the facility pumping about 4 acre-feet per year (afy). Normally, Well-12 cycles on and off based on tank water level. When operating, Well-12 pumps at about 30 gpm. Well-12 is regulated as a County Small Water System well and is tested regularly for water quality (as required by California Department of Health Regulations). The water usage estimate for the project, which includes minimal irrigation and all other potable and non-potable water usage, is about nine afy. A plot plan with onsite and offsite well locations is presented as Figure 5 in Section 2.4.

1.3 Applicable Groundwater Regulations

Since the California Environmental Quality Act (CEQA) requires that environmental impacts be assessed for each project, and since increased groundwater usage is a potential impact, this project is subject to analysis by CEQA. This groundwater investigation was performed in conformance with the *County Groundwater Ordinance* and the County's *Guidelines for Determining Significance and Report Format and Content Requirements – Groundwater Resources.* Section 87.722.B. of the Groundwater Ordinance has the following finding that must be made for this project: "*The application shall not be approved unless the approving authority finds, based upon the Groundwater Investigation or other available information…that groundwater resources are adequate to meet the groundwater demands of the project.*"

The project is required to perform a water balance analysis to evaluate cumulative impacts to groundwater resources. A water balance analysis provides a first level evaluation of determining sustainable yield. The Guidelines define a reduction of more than 50 percent of the theoretical initial volume of groundwater in storage as a significant impact. Assessment of well interference is also required to evaluate direct impacts to groundwater resources as a result of this project.

This is discussed in the following sections. No other potential impacts were analyzed as part of this investigation.

2.0 EXISTING CONDITIONS

2.1 Topographic Setting

The project site is situated on a relatively narrow alluvium-filled valley and surrounded by highlands to the east and west of the site. A watershed boundary map with the project location is presented as Figure 2. Elevations in the watershed range from about 2,780 feet above msl in the south to about 3,840 feet above mean sea level (msl) on Cameron Mountains in the northeast part of the basin. Surface drainage flows toward the intermittent creek that parallels Buckman Springs Road in the center of the watershed and exits the basin in the south.

2.2 Climate

Precipitation

According to the County's *Groundwater Limitations Map*, the project site and the surrounding basin are located in the 18 to 21-inch mean annual rainfall belt (Figure 3). Over the past 40 years, annual rainfall totals at the Morena Reservoir Rainfall Station have ranged from about 3.6 to 41.4 inches. The average annual rainfall for this station is 19.21 inches for that period. The Morena Reservoir Rainfall Station is located less than 4 miles northwest of the project site at an elevation of 3,075 feet above msl and within the same rainfall belt as the project site. Rainfall data for this station were recorded monthly and are complete for the rainfall years (July through June) 1967/1968 through 2007/2008 (Appendix A).

The Campo rainfall gauge is located approximately 2 miles southeast of the project site at an elevation of 2,630 feet above msl. The Campo rainfall gauge lies inside the border of the 16 to 18-inch mean annual rainfall belt (Figure 3); but the average annual rainfall for this station is about 15.8 inches for the period 1973 – 2002 (Wiedlin and Associates 2006).

Evapotranspiration

In contrast to evapotranspiration (ET), which is defined as a combined process of evaporation from soil and plant surfaces, and transpiration through plants; potential evapotranspiration (PET) is the amount of water transpired through an irrigated non-specific short green crop. Reference evapotranspiration rates (ETo), obtained from the California Irrigation Management Information System (CIMIS) ET_O map is a measure of

PET from a known surface, such as grass or alfalfa. The reference ET_O for this zone (Zone 16) is 62.51 inches.

Evaporation

Since pan evaporation rates were not available for the basin, the reported average annual pan-corrected evaporation rate of 58.3 inches from Lake Morena Reservoir was used along with Zone 16 reference evapotranspiration rates (ETo) [62.51 inches] from CIMIS. ETo rates were averaged with evaporation data and used in a computer program called *Recharg2*, which solves the soil moisture balance equation. ETo and evaporation rates are provided on Table 1.

Table 1. Evaporation and Reference Evapotranspiration Rates

	JUL	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**TOTAL**
ETo (inches)	9.30	8.37	6.30	4.34	2.40	1.55	1.55	2.52	4.03	5.70	7.75	8.70	62.51
Evaporation (inches)	8.58	8.07	6.61	4.97	2.84	1.84	1.95	2.27	3.35	4.62	5.95	7.25	58.30
Average (inches)	8.94	8.22	6.46	4.66	2.62	1.70	1.75	2.40	3.69	5.16	6.85	7.98	60.41

2.3 Land Use

Land use in the watershed currently consists of large lot single-family residences and open space. These residential developments are dependent on groundwater. Land use designations were determined from the San Diego County Land Use Element map (Figure 4) of the Lake Morena/Campo Area (County of San Diego 2011). The subject property is mainly designated *Rural Land 20-acre* while the majority of land within the watershed (about 1,755 acres) is designated as *Semi-Rural Residential 10-acre*. Semi-Rural Residential areas are defined as land designated for lower-intensity uses, such as estate-style residential lots and agricultural operations having minimum allowable parcel sizes (0.5, 1, 2, 4, and 10 acres) based on slope criteria and other constraints. Additional designated land uses found within the watershed are: *Rural Land 40-acre*; *Rural Land 40-acre*, and *Public Agency* (National Forest

For purposes of this study, it was assumed that no development would occur in the approximately 185 acres of *Public Agency* land within the basin. There are about 177 (partial and whole) undeveloped private lots within the watershed. Based on open space easements, the general plan (GP), which takes into consideration slope and other criteria, and the *Groundwater Ordinance*, which limits lot sizes to 5 acres within the 18 to 21 inch rainfall belt, this land could be developed into about 263 single-family homes. Additional limitations, such as steep slopes and unfavorable conditions for septic system were not considered.

2.4 Water Demand

Three water demand scenarios were evaluated: 1) current project and current basin demand, 2) proposed project and current basin demand, and 3) proposed buildout and maximum theoretical basin buildout (based on the current County General Plan) demand. Based upon aerial imagery and a search of parcel/well completion records, there are about 69 existing dwelling units within the approximately 1,940-acre basin. In addition, a 3.9-acre vineyard is located within the watershed. Figure 5 depicts the location of the offsite vineyard and the parcels with well completion reports reviewed. Assuming an average demand of 0.5 afy for each residence within the basin, 2 afy per acre for the vineyard, and the current Freedom Ranch facility water use, current groundwater demand in the basin is about 47 afy as summarized on Table 2.

Table 2. Current Project Estimated Basin Groundwater Demand

Use Type	**Quantity**	**Water Demand**	**Total Use (afy)**
On-Site Water Demand			
Men in Active Treatment	50	50 gpd	2.80
Residential Staff	5	50 gpd	0.28
Non-residential Staff	3	15 gpd	0.05
Garden	5,000 square feet	2 afy/acre	0.23
Ducks	5	5 gpd/animal	0.03
Small Orchard	0.3 acre	3.4 afy/acre	1.02
		Subtotal	**4.4**
Off-Site Water Demand			
Off-site Residential	69 homes	0.5afy/home	34.5
Off-site Vineyard	**3.85 acres**	**2 afy/acre**	**7.7**
Total Current Estimated Groundwater Demand			**46.6**

The water demand for the proposed project and current basin buildout is about 52 afy and summarized on Table 3.

Table 3. Proposed Project and Current Estimated Basin Groundwater Demand

Use Type	**Quantity**	**Water Demand**	**Total Use (afy)**
On-Site Water Demand			
Men in Active Treatment	125	50 gpd	7.00
Residential Staff	10	50 gpd	0.56
Non-residential Staff	6	15 gpd	0.10
Garden	5,000 square feet	2 afy/acre	0.23
Ducks	5	5 gpd/animal	0.03
Small Orchard	0.3 acre	3.4 afy/acre	1.02
Contingency			1.06
		Subtotal	**10.0**
Off-Site Water Demand			
Off-site Residential	69 homes	0.5afy/home	34.5
Off-site Vineyard	**3.85 acres**	**2 afy/acre**	**7.7**
Total Anticipated Groundwater Demand at Current Basin Buildout			**52.2**

The estimated water demand at basin buildout is about 132 afy for other residences within the basin. Onsite groundwater demand for the project is expected to increase from about four to 10 afy. Actual on-site water usage is expected to be about 9 afy, but one afy is included as a contingency to cover sporadic periods of high demand. This contingency reduces risk of Code enforcement or the need for another MUP modification for minor changes in the future. No significant agricultural demands in the basin are anticipated at buildout. The water demand for the proposed project and maximum basin buildout is about 149 afy and summarized on Table 4.

Table 4. Anticipated Groundwater Needs at Maximum Buildout

Use Type	**Quantity**	**Water Demand**	**Total Use (afy)**
On-Site Water Demand			
Men in Active Treatment	125	50 gpd	7.00
Residential Staff	10	50 gpd	0.56
Non-residential Staff	6	15 gpd	0.10
Garden	5,000 square feet	2 afy/acre	0.23
Ducks	5	5 gpd/animal	0.03
Small Orchard	0.3 acre	3.4 afy/acre	1.02
Contingency			1.06
		Subtotal	**10.0**
Off-Site Water Demand			
Off-site Residential	263 homes	0.5afy/home	131.5
Off-site Vineyard	3.85 acres	2 afy/acre	7.7
Total Anticipated Groundwater Demand at Maximum Buildout			**149.2**

2.5 Geology and Soils

<u>General</u>

The proposed project is located in the east-central portion of the Peninsular Ranges Province, a California geomorphic province with a long and active geologic history. This portion of the province is predominantly composed of rocks of the Southern California Batholith and generally consists of Mesozoic-aged granitic rocks with alluvium-filled valleys. Aerial photos indicate lineaments (potential fractures, joints, and faults) in the Campo area. These lineaments predominantly trend in a roughly north-south direction. Recent alluvium, which typically consists of river and stream deposits, underlies the project site and is abundant in the drainages within the watershed. An additional rock type that underlies the watershed is the Bonsall Tonalite, which is a light-gray massive quartz diorite characterized by abundant streaked dark inclusions. The northern portion of the watershed is underlain by the Woodson Mountain Granodiorite, which is a light-colored granodiorite that weathers along joints to form huge white or pink, rounded knobs (California Division of Mines and Geology 1962).

These “granitic” or “granitoid” rocks underlying much of the watershed have a mantle of weathered rock known as residuum or decomposed granite, which is formed from the in-place chemical weathering of rock. The contact between the residuum and the unweathered bedrock varies throughout the area. Although bedrock outcroppings are common in the upland areas throughout the watershed, the project site is located in the valley area of the watershed where significant amounts of residuum and alluvium exist. Differential weathering of bedrock due to non-uniform fracturing and differences in mineralogy produces an undulating contact between the unweathered bedrock and residuum. In general, weathering is deeper in flat and valley bottom areas, and thinner in steeper upland areas. In addition, a significant amount of alluvium, which was derived by weathering and erosion of granitic rock along the valley slopes, exist in the drainages within the basin particularly along Buckman Springs Road. Although well logs for the onsite wells were not available, based on a review of 69 well completion reports, offsite wells in the valley area have well depths that reportedly range from about 86 to 300 feet bgs. These wells along with the onsite wells were likely completed primarily in alluvium and residuum. A basin hydrogeologic units map with a California geologic units insert is provided as Figure 6.

Soils

Based on the San Diego Area Soil Survey (United States Department of Agriculture 1973), soils that make up the watershed are classified as follows:

- The Tollhouse series, which consists of excessively drained, shallow to very shallow, rocky coarse sandy loams. The soils of the Tollhouse series formed in place from weathered granodiorite and have slopes of 5 to 65 percent. These soils are found in mountain areas throughout the watershed.
- The Mottsville series consists of excessively drained, very deep, loamy coarse sands that in some areas are formed in sandy sediments transported from granitic rock, and in other areas are formed from weathered-in-place granitic rock. The soils of the Mottsville series occur in the valley areas throughout the watershed, make up the entire project site, and have slopes of 2 to 9 percent.

- The Calpine series consists of well-drained, very deep coarse sandy loams that formed in granitic alluvium. These soils are on alluvial fans and have slopes of 5 to 15 percent.
- The La Posta series consists of somewhat excessively drained loamy coarse sands that formed in material weathered from granodiorite. These soils are found on mountainous uplands within the watershed and have slopes of 5 to 30 percent.
- The Sheephead series consists of well-drained, shallow fine sandy loams that formed in material weathered from micaceous schist and gneiss. These soils are found on mountainous uplands and have slopes of 30 to 65 percent.
- Acid igneous rock land is rough broken terrain. The topography ranges from low hills to very steep mountains with large boulders and rock outcrops of tonalite and granodiorite. The soil material is loam to loamy coarse sand in texture and is very shallow over residuum or basic igneous rock. In a few places there are pockets of deep soil between the rocks.

The soil types of the watershed with their respective moisture-holding capacities and runoff potentials are noted in Tables 5, 6 and 7. A soils map is provided as Figure 7.

Table 5. Dominant Soil Types in Steeper Areas

Name	**Moisture Holding Capacity (inches)**	**Runoff Potential**	**Approximate Area within 1,940-Acre Watershed (acres)**
Acid Igneous Rock	0-1*	very rapid	48
Sheephead rocky fine sandy loam (30 to 65% slopes)	2-3	medium to rapid	65
Tollhouse rocky coarse sandy loam (30 to 65% slopes)	1-2	medium to rapid	100
Total			***213***

*Assumed value.

Table 6. Dominant Soil Types in Mid-Slope Areas

Name	Moisture Holding Capacity (inches)	Runoff Potential	Approximate Area within 1,940-Acre watershed (acres)
La Posta loamy coarse sand (5 to 30% slopes, eroded)	2-3	medium	282
La Posta loamy coarse sand (5 to 30% slopes, severely eroded)	1-2	medium	38
La Posta rocky loamy coarse sand (5 to 30% slopes)	1-2.5	medium	22
Tollhouse rocky coarse sandy loam (5 to 30% slopes)	1-2	medium to rapid	434
Total			***776***

Table 7. Dominant Soil Types in Flatter Areas

Name	Moisture Holding Capacity (inches)	Runoff Potential	Approximate Area within 1,940-Acre watershed (acres)
Calpine coarse sandy loam (5 to 9% slopes)	4.5-6.5	slow to medium	421
Calpine coarse sandy loam (9 to 15% slopes, eroded)	4.5-5.5	medium	253
Mottsville loamy coarse sand$^+$ (2 to 9% slopes)	4-5	slow to medium	278
Total			***952***

$^+$ Comprises the entire project site.

Based on Tables 5, 6 and 7, we have assumed representative values for moisture holding capacity and maximum runoff for the site and the entire 1,940-acre watershed consistent with similar projects in adjacent watersheds (Wiedlin and Associates 2006). Those values are provided on Table 8.

Table 8. Moisture Holding Capacity and Maximum Runoff

Area	Moisture Holding Capacity (inches)	Maximum Runoff (Percent)
Steeper Areas	1.7	30
Mid-Slope Areas	2.0	25
Flatter Areas	5.1	20

2.6 Hydrogeologic Units

Aquifer watershed boundaries are generally assumed to be coincident with surface water boundaries. The subject property and watershed are part of the larger Campo Valley watershed, which includes over 70 square miles. Groundwater within the subject watershed generally flows towards Campo Creek to the south and exits the larger Campo Valley watershed to the west.

Since groundwater levels in upland areas are deeper than the alluvium and/or residuum contact with bedrock, fractured bedrock represents a significant water-bearing unit in much of the basin. Because water can only occupy the fractures in the unweathered rock, specific yields (essentially equivalent to the interconnected [or effective] porosity) in this rock are generally lower than in residuum and alluvium. Specific yields in fractured rock wells are generally on the order of 10^{-6} to 10^{-2} (0.0001% to 1%). Specific yield values of 10^{-4} and 10^{-3} (0.01 % and 0.1% respectively) were used for fractured rock in the slopes and flatter areas, respectively. A review of aerial photographs indicates a few lineaments (potential fault and/or fracture zones) in the Campo area. Various fractures within this aquifer may be only partially interconnected, thereby restricting the hydraulic connection and groundwater flow. Wells in fractured rock are typically on the order of 200 to 1,000 feet deep.

Residuum is a zone of relatively high intergranular porosity and moderate permeability. Water that infiltrates this zone fills the voids in the residuum and slowly leaks into the underlying fractured rock. Significant amounts of residuum are thought to exist in the lower elevations in the central part of the watershed and on the project site. Based on a review of available well completion reports, a significant amount of residuum exists in basin. The average thickness of saturated residuum is estimated to be about 35 feet. Specific yields in residuum are assumed to be on the order of 0.01 to 0.1 (1% to 10%

respectively). A specific yield value of 0.05 (5%) was used for this investigation.

According to a review of well completion reports and surface features, alluvium exists in the drainage areas along Buckman Springs Road and the project site. The zone of saturation is assumed to be 10 feet deep within the alluvium in the main drainage. A specific yield value of 0.05 (5%) was used for this investigation. Actual values typically vary from 0.01 (1%) to 0.20 (20%).

2.7 Water Quality

Per email direction from the County Groundwater Geologist dated January 04, 2012, AECOM did not perform water quality sampling of onsite wells. However, Well-12 ,a Transient Non-Community regulated County Small Water System well (and known as Well-3 by the Department of Environmental Health), is tested regularly for total coliform, Escherichia coli (*E. coli)*, and nitrate (reported as both nitrogen and NO_3). Water samples are collected by the water system operator in laboratory-provided bottles, kept on ice, and sent to EnviroMatrix Analytical (a California-certified laboratory) to be analyzed. Descriptions of analytical methods, preservation methods, and analytical results are provided on Table 9 and Appendix B. None of the results listed below exceeded maximum contaminant levels (MCLs).

Table 9. Well-12 (Small Water System Well 3) Analytical Results

	Nitrate-N	**Nitrate-NO_3**	**Total Coliform**	**E. Coli**
Analytical Method	SM4500	Calculated	SM9223B	SM9223B
MCL	10 mg/L	45 mg/L	Not Detectable	Not Detectable
Date	**Results**			
08-Mar-2012	N/A	N/A	Absent	Absent
23-Mar-2012	0.38	1.66	Absent	Absent
04-Dec-2012	N/A	N/A	Absent	Absent

Notes:

E. coli - Escherichia coli
mg/L – milligrams per liter
MCL – Maximum Contaminant Level
N/A – Not Analyzed
NO_3 – Nitrate

3.0 WATER QUANTITY IMPACT ANALYSIS

3.1 50% Reduction of Groundwater in Storage

3.1.1 Guidelines for Determination of Significance

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

3.1.2 Methodology

In order to determine if there is sufficient groundwater to support basin demand, the amount of groundwater that recharges the aquifer must be estimated along with the amount of water stored in the aquifer. These values are compared with the anticipated groundwater demand at basin buildout to determine the safe yield of the basin. By estimating the amount of water entering the basin and the amount of water leaving the basin, we can determine when and if basin storage will drop below the 50 percent threshold. The following sections detail how recharge, demand and storage were calculated.

3.1.2.1 Groundwater Recharge

Infiltration of precipitation can be estimated by calculating the amount of precipitation that percolates through the soil root zone to reach the underlying groundwater system after accounting for losses due to runoff, evapotranspiration, and field capacity (soil moisture capacity). The soil moisture balance equation commonly used to estimate groundwater recharge due to rainfall is:

$$R_i = P_i - RO_i - pET_i - (SMC - SM_i)$$

Where:

R_i = Recharge during the ith month (inches)

P_i = Precipitation during the ith month (inches)

RO_i = Runoff during the ith month (inches)

pET_i = Potential evapotranspiration during the i^{th} month (inches)

SMC = Soil moisture holding capacity (inches)

SM_i = Soil moisture at beginning of the i^{th} month (inches)

Runoff can be estimated as a function of the average monthly moisture content of the soil using the following equation:

$$RO_i = RO_{\max} x \frac{\frac{SM_i + SM_{i+1}}{2}}{SMC}$$

where:

RO_i = Runoff during the i^{th} month (inches)

RO_{max} = Maximum runoff potential (percent)

SM_i = Soil moisture at beginning of the i^{th} month (inches)

SM_{i+1} = Soil moisture at end of i^{th} month (inches)

SMC = Soil moisture holding capacity (inches)

Because the project site lies between the Campo rainfall gauge (15.8 inch annual average from 1973 to 2002) and the Morena Reservoir rainfall station (19.21 inch annual average from 1968 to 2008), and the elevation of the Morena Reservoir gauge is approximately the median elevation of the watershed, a distance-and-elevation-based-fractionalization factor was applied to the Lake Moreno rainfall data. The corrected annual rainfall average used in the water balance analysis was 18.00 inches for the 40-year period. This is a conservative approach.

This information along with an average of evaporation rates and reference evapotranspiration rates (Section 2.2 and Table 1) was used in a computer program called *Recharg2*, which solves the soil moisture balance equation.

Utilizing these data in the *Recharg2* program, we calculated the average rainfall recharge, runoff value, and average annual rainfall recharge volume for the site and the 1,940-acre watershed (Table 10). The output from the *Recharg2* program is presented in Appendix C.

Table 10. Rainfall Recharge

Area	Average Annual Recharge (inches)	Average Annual Runoff (percent)	Area in Watershed (acres)	Average Recharge Volume (afy)
Steeper Areas	2.40	11.27	213	42.6
Mid-Slope Areas	2.56	9.39	776	165.3
Flatter Areas	1.77	6.09	952	140.1
			Total Recharge in Watershed	*348*

3.1.2.2 Groundwater Demand

Currently, there are about 70 well users within the watershed. These are primarily single family residences. As shown in Table 4, at maximum buildout, projected groundwater demand for the basin under the GP is expected to be about 149 afy (10 onsite and 139 offsite).

3.1.2.3 Groundwater in Storage

Because there are often many years with little to no recharge, punctuated by years of abundance, water in storage must be adequate to provide for many years without recharge. Although actual site-specific storativity values are not known, these values can be estimated for purposes of this study. Assuming a saturated thickness of 500 feet and specific yield values of 10^{-3} (0.1%) in valleys and mid-slope areas and 10^{-4} (0.01%) on steeper slopes and upland areas, an estimated 864 acre-feet of groundwater may be in storage in the fractured rock within the 1,940-acre watershed.

Based on an assumed specific yield value of 0.05 (5%), a saturated thickness of 35 feet, and approximately 910 acres of saturated residuum (based on a review of available well completion records) there are an estimated 1,593 acre-feet of groundwater in storage in the residuum within the 1,940-acre watershed.

Based on a review existing well completion reports and surface features, approximately 15 acres of saturated alluvium are thought to exist in the watershed. Assuming a specific yield value of 0.05 (5%) in alluvium and a saturated thickness of 10 feet, there are an estimated 7.5 acre-feet of groundwater in storage in the alluvium within the 1,940-acre watershed.

The total calculated storage in the 1,940-acre watershed is estimated to be about 2,474 acre-feet.

Table 11. Groundwater in Storage (acre-feet)

Unit	Approximate Area (acres)	Average Saturated Thickness (feet)	Specific Yield	Water in Storage (acre-feet)
Fractured Bedrock (flatter or valley areas)	1,727	500	0.001(0.1%)	863.5
Fractured Bedrock (slopes)	213	500	0.0001(0.01%)	10.7
Residuum	910	35	0.05 (5%)	1,592.5
Alluvium	15	10	0.05 (5%)	7.5
			Approximate Total in Watershed	***2,474***

3.1.2.4 Long-Term Groundwater Availability

In order to estimate long-term sustainable yield for the watershed, a maximum storage volume 2,474 acre-feet was used. Appendix D contains three tables that estimate water in storage in the watershed for the period of 1967/1968 to 2007/2008 for the three development scenarios outlined in Tables 2 through 4 (current project and current basin, proposed project and current basin, and proposed project and maximum theoretical basin buildout).

Our storage calculations assumed that the watershed was full (i.e., contained 2,435 acre-feet of water) in 1967. In addition, we assumed that the watershed could not hold more than 2,435 acre-feet; therefore, if rainfall recharge was calculated to be in excess of this value, it was assumed the balance would run off, rather than recharge the groundwater system. These three scenarios estimated that 46.6, 52.2, and 149.2 afy would be required respectively. In accordance with the Guidelines for Determining Significance, storage cannot drop below 50 percent (or 1,237 acre-feet for the watershed) of maximum storage. Based on these calculations, the watershed could sustain the proposed development at maximum buildout. The lowest percent of maximum groundwater in storage is estimated to be 60%. Because these calculations are heavily dependent on the assumed storage coefficient, runoff, and other conditions, actual sustainable yield would be expected to vary from these estimates. But nonetheless, they are useful for these purposes.

Long-term sustainable groundwater yield is a function of several factors including rainfall recharge, streambed infiltration, groundwater inflow, septic system recharge, irrigation return flow, groundwater extraction, phreatophyte loss, baseflow, other groundwater users in the watershed, and groundwater outflow. The primary factors affecting sustainable yield in this basin are assumed to be basin-wide groundwater extraction at maximum buildout and rainfall recharge. Although groundwater outflow is unknown, it is expected to decrease over time as a result of increased groundwater extraction within the watershed. The other factors are expected to be insignificant or non-existent in this basin.

3.1.3 Significance of Impacts Prior to Mitigation

Based on the criterion of a 50 percent or greater reduction in groundwater storage within the basin over a period of 40 years (discussed in 3.1.1 above) , impacts to groundwater are not anticipated to be significant for this project.

Table 12. Summary of Water Demand Scenarios and Basin Storage Analysis

Scenario	Total Water Demand (afy)	Maximum Amount of Groundwater in Storage (af)	Average Amount of Groundwater in Storage (af)	Minimum Amount of Groundwater in Storage (%)
Current Project and Basin Buildout	46.6	2,474	2,417	89%
Proposed Project and Current Basin Buildout	52.2	2,474	2,406	87%
Proposed Project and Maximum Theoretical Basin Buildout	149.2	2,474	2,151	60%

3.1.4 Mitigation Measures and Design Considerations

No measures to mitigate for a reduction in groundwater storage are proposed for this project.

3.1.5 Conclusions

Groundwater in storage is not anticipated to be a significant impact for this project since the 40-year water budget indicates that groundwater storage does not drop below the 50 percent threshold for any given year. Based on this criterion, impacts to groundwater are less than significant.

3.2 Well Testing

AECOM completed a pumping test plan and 72-hour constant rate pumping test in accordance with County Groundwater Geologist request as discussed below.

3.2.1 Pumping Test Plan

On March 7, 2012 AECOM submitted a pumping test plan to the County Groundwater Geologist requesting a 24-hour constant-rate pumping test. After reviewing the plan, the County Groundwater Geologist, in an email to AECOM on April 5, 2012, revised the required pumping time to 72 hours and requested a revised pumping test plan be submitted. AECOM prepared and submitted the revised 72-hour pumping test plan and it was subsequently accepted by County on April 6, 2012.

3.2.2 72-hour Constant-Rate Pumping Test

AECOM performed a 72-hour constant-discharge pump test on Well-12 from April 24 through April 27, 2012 using the existing submersible pump installed at approximately 270 feet below top of casing (TOC). The pumping test was conducted at a constant rate of about 18.7 gallons per minute (gpm). Water levels were measured both with an electric water level meter and a pressure transducer in the pumping well and nearby Well-13. Manual water level measurements were collected from onsite monitoring Well-A and offsite Wells-C and -E. Flow was measured with an in-line flowmeter, and water was discharged through the existing water line to the nearly empty water storage tank. When the tank became full, the discharge water was spread on the ground at least 100 feet down-gradient of the production well.

At the conclusion of pumping, AECOM monitored recovery with transducers in pumping Well-12 and monitoring Well-13 for a period of 69 hours. Off-site Wells –C and -E and on-site Well-A were monitored manually for 69 hours. Although there were fluctuations before, during and after testing, there was no drawdown associated with this pump testing observed in three of the four unpumped monitoring wells (Wells-E, -C and -A) throughout the duration of the test. Pumping Well-12 had a maximum drawdown of approximately 11.1 feet. Monitoring Well-13 (approximately 137 feet west of Well-12) had a maximum drawdown of about 2.49 feet. Table 13 summarizes the drawdown in the pumping and observations wells. Section 3.3 discusses and presents graphically the drawdown and recovery plots for Well-12 and Well-13.

Table 13. Maximum Associated Drawdown from Well-12 Pump Test

Well Name	Distance from Production Well (feet)	Depth to Groundwater at Beginning of Pump Test (feet bgs)	Depth to Groundwater at End of Pump Test (feet bgs)	Maximum Drawdown Associated with Pump Testing (feet)
Well-12	N/A	50.05	59.5	11.1
Well-13	137	44.60	46.85	2.49
Well-E	800	56.85	56.35	0
Well-C	1,250	40.65	42.95[a]	0
Well-A	1,500	38.03	38.05	0

Notes: N/A: not applicable
[a] pump was in use at time of water level measurement

3.3 Evaluation of Pump Test Data

3.3.1 Drawdown

Aquifer transmissivity (i.e., the capacity to transmit water) can be estimated using the Cooper-Jacobs approximation (Cooper 1946) to the Theis equation, which states:

$$T = 2.3\, Q/4\, \pi\, \Delta s$$

Where:

T = Transmissivity (feet^2/minute)

Q = Discharge rate (feet^3/minute)

Δs = Drawdown (or residual drawdown) over 1 logarithmic cycle

Based on this equation, we calculated the following transmissivities for Wells-12 and 13 in Table 14.

Since aquifer thickness and transmissivity do not remain constant with time, the Jacob correction was used to correct measured drawdown during pumping and recovery. These corrected drawdown data are plotted against the logarithm of time since pumping started. Corrected recovery data are plotted against the ratio of time since pumping started divided by time since pumping stopped (t/t').

Table 14. Calculated Transmissivities

Well Name	Transmissivity (feet^2/day)[1]	
	Drawdown	Recovery
Well-12 – Early Time	820	120
Well-12 – Late Time	300	
Well-13 – Early Time	2,200	260
Well-13 – Late Time	310	
Arithmetic Mean	910	190

Notes: [1]Rounded to the two significant figures.

Storativity can be estimated using the Theis time-drawdown method which states:

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

Where:

S = Storage (dimensionless)

T = Transmissivity (feet^2/minute)

t_o = Time drawdown is extrapolated to be 0 (minute)

r = distance to pumping well (feet)

Based on this equation, we used drawdown data in observation Well-13 to estimate storativity to be between 0.007 (0.7%) and 0.0007 (0.07%).

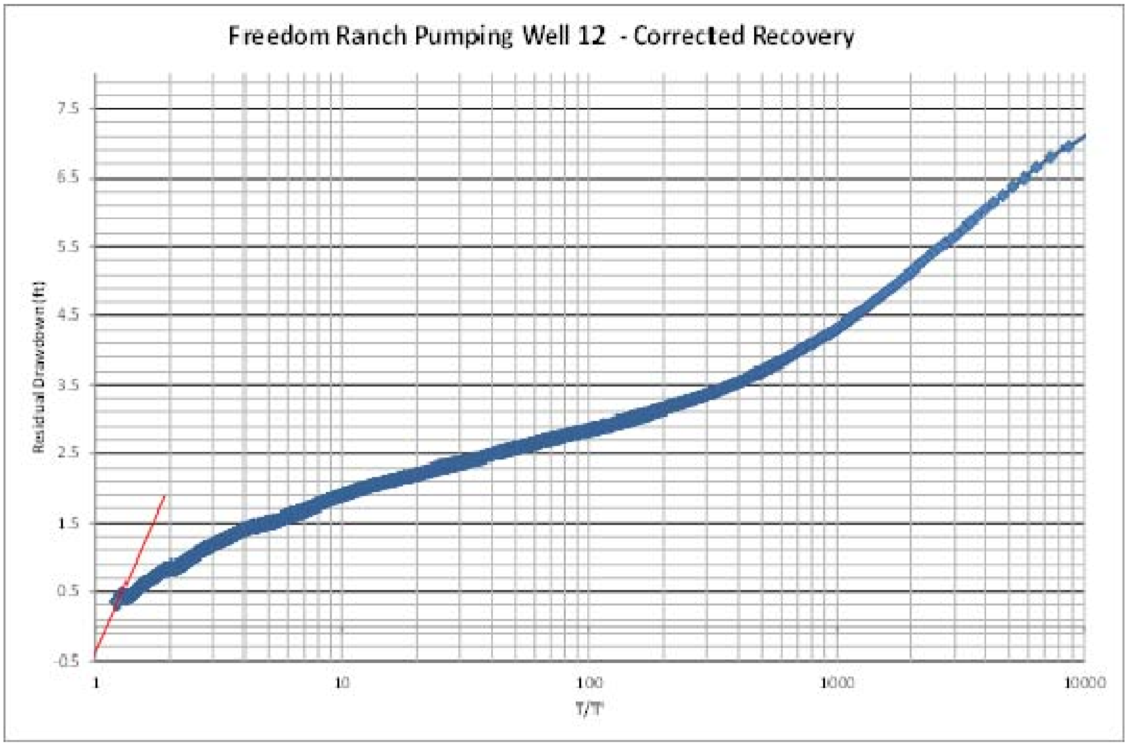
The initial water level (with 0.6 feet of pre-existing residual drawdown in Well-12) was 50.05 feet bgs. Wells 13, A, C, and E were monitored throughout the duration of the test. A flow rate of approximately 18.7 gpm was maintained throughout the test. The total volume pumped during the 72-hour test was about 80,590 gallons. With a 6½-inch diameter borehole, this represents approximately 187 well-bore volumes. After 72 hours of pumping, the maximum drawdown was 11.1 feet, which equals a specific capacity of 1.7 gpm per foot.

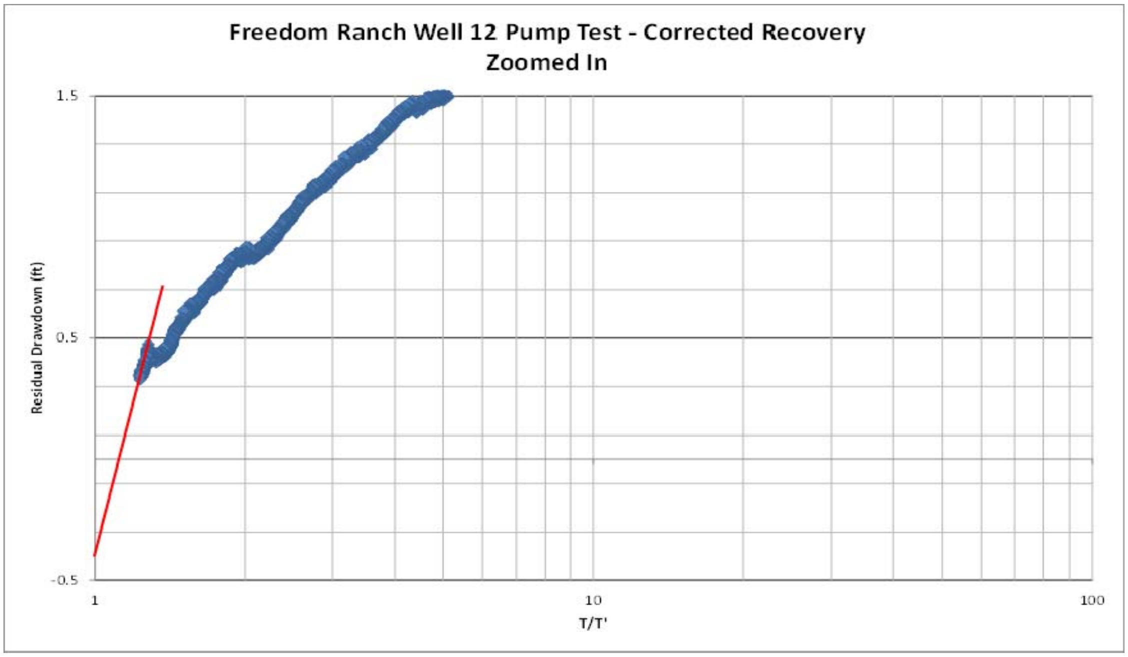
3.3.2 Recovery

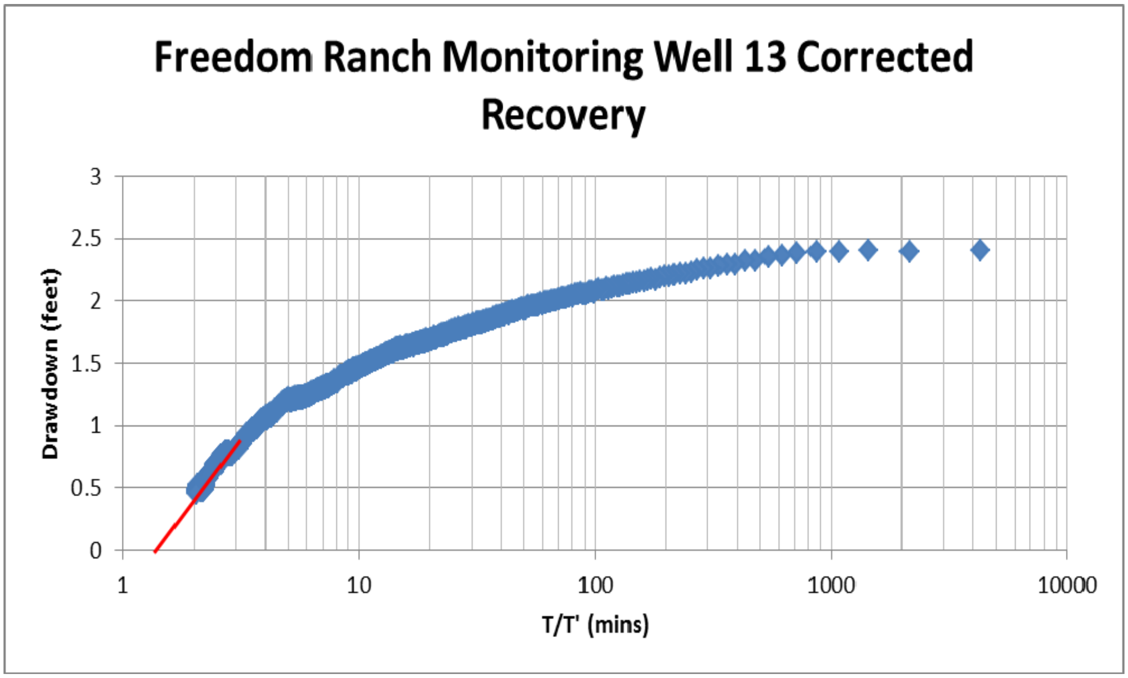
Recovery extrapolated to t/t’ = 1 (infinite time) indicates no residual drawdown. Including the drawdown remaining from the initial pumping, the residual drawdown is still less than 0.5 feet. According to Section 4.4.2 (Residual Drawdown Guideline) of the County Guidelines for Determining Significance and Report Format and Content Requirements, “*Where analysis of a residential well test indicates that greater than 0.5 feet of residual drawdown is projected, the project will be considered to have a significant impact … 0.5 feet was selected rather than zero feet which takes into account potential minor inaccuracies.”*(County of San Diego 2007). Based on this guidance, pumping Well-12 is not considered to be a significant impact to groundwater resources. Well-13 is predicated to have no residual drawdown.

Recovery data were evaluated to assess long-term affects to the groundwater system. Data plots of residual drawdown versus time since pumping started, divided by time since pumping stopped (t/t’), graphed on semi logarithmic paper, and were evaluated to assess impacts to storage from pumping. At t/t’ equal to 1, a residual drawdown would indicate permanent aquifer dewatering.

Corrected recovery in Well-12, zoomed-in Well-12, and Well-13 are shown on the figures below:


Freedom Ranch Pumping Well 12 - Corrected Recovery
Residual Drawdown (ft)
7.5
6.5
5.5
4.5
3.5
2.5
1.5
0.5
-0.5
1
10
100
1000
10000
T/T'


Freedom Ranch Well 12 Pump Test - Corrected Recovery
Zoomed In
Residual Drawdown (ft)
1.5
0.5
-0.5
1
10
100
T/T'



3.3.4 Predicted Five-year Drawdown

Numerical groundwater flow modeling using USGS MODFLOW was used to predict 5-year drawdown from production We1l-12. The groundwater flow model was constructed as a single layer grid approximately 300-feet thick with 10-foot cell spacing 10,560 feet long by 4,860 feet wide with Well-12 at its center. Constant-head boundaries were assigned to the upgradient and downgradient edges of the model in order to produce groundwater flow directions and gradients that roughly approximate the land surface down the center of the model domain. This model layer represents the residuum and upper fractured rock penetrated by Well-12. The model was calibrated to the observed response of the 3-day constant-rate pump test conducted at Well-12 in April 2012. The model calibration resulted in a reasonable fit with a transmissivity of 170 feet^2/day and a storativity value of 0.01 (1%). The calibrated transmissivity value was within the range of values obtained from the pump test data (120 to 2,200 feet^2/day). Typical storativity values are between 0.001 (0.1%) and 0.0001 (0.01%) in fractured rock, and 0.01 (1%) to 0.05 (5%) in residuum. Although the storativity results obtained from the pump test (0.007 [0.7%] to 0.0007 [.07%]) are one to two orders of magnitude less than the calibrated model value (0.01), we believe that the calibrated storativity is reasonable for this purpose.

The model was then used to predict five-year drawdown based on an assumed steady-state project groundwater demand of 10 afy (6.2 gpm). The predicted 5-year drawdown results are presented in the following table and shown on Figure 8.

Table 15. Predicted 5-Year Drawdown from Steady-State Pumping of Well-12

Well Name	Distance from Production Well (feet)	Projected Rate (gpm)	Predicted Drawdown After Five Years at Projected Use Rate (feet)
Well-12	N/A	6.2	9.7
Well-13	137	N/A	4.8
Well-E	800	N/A	3.3

Notes: N/A: not applicable

This is a superposition model which only considers the effects of pumping Well-12. These impacts would be superimposed on other stresses such as pumping from other off-site wells and recharge. The maximum predicted 5-year drawdown at the proposed project boundary is about 3.25 feet (Figure 8).

Due to the heterogeneity and anisotropy of the hydraulic parameters of the represented geologic units, the unknown lateral and vertical extents of the saturated residuum, seasonal and long-term basin wide recharge, and the simplifying assumptions inherent in this type of modeling, these results should be viewed as estimates only.

Based on the representative aquifer parameters, the saturated depth of water above the pump intake, and County guidance for determination of significance (predicted 5-year drawdown in offsite wells shall not exceed 20 feet for fractured rock wells) on-site pumping should not pose a significant impact to offsite wells.

4.0 SUMMARY OF PROJECT IMPACTS AND MITIGATION

Based on the 40-year water balance, the project is not expected to exceed the threshold of significance. Therefore, the impacts resulting from the reduction in groundwater in storage for this project are considered less than significant.

Based upon the results of our study, we provide the following conclusions:

- The Project is expected to require about 9 afy of groundwater for expanded operations. To be conservative, a value of 10 afy was used in this analysis.

- The long-term average annual recharge to the 1,940-acre basin is expected to be approximately 350 afy.
- According to the GP, the basin could be developed into an estimated 263 homes. Annual extraction for the expanded Freedom Ranch project plus a fully developed basin is expected to be in the neighborhood of 149 afy. This estimate is based on the assumption that groundwater demand will average 0.5 afy per dwelling (in accordance with the San Diego County Groundwater Ordinance).
- Based on these conclusions, basin-wide extraction of up to 149 afy (including the proposed project) under the GP could be sustained without reducing groundwater in storage to less than 50%.
- A total of approximately 2,474 acre-feet of groundwater are thought to be in storage in the alluvium, residuum and fractured rock in the study area. The lowest percent of maximum groundwater in storage is at maximum buildout is about 60%. Based on our water balance calculations for the GP, groundwater in storage is not anticipated to be a significant impact for the project.
- Development in excess of the projected basin buildout densities may result in an overdraft condition during prolonged periods of below average rainfall.
- Estimated residual drawdown in pumping Well-12 and monitoring Well-13 are about 0.2 feet and less than 0 feet respectively. Based on these results and County guidance for determination of significance (predicted residual drawdown shall not exceed 0.5 feet) the project should not pose a significant impact.
- Using the results of the 72-hour pumping test completed in April 2012, an estimated project water demand of 6.2 gpm (10 afy), and modeling results, we estimate that the 5-year drawdown in pumping Well-12 and nearby Well-13 (about 137 feet from Well-12) would be about 9.7 and 4.8 feet, respectively. Based on the representative aquifer parameters (transmissivity = 170 feet^2/day, storativity = 0.013) and the saturated depth of water above the pump intake, on-site pumping should not pose a significant impact to onsite wells.

- Estimated 5-year drawdown in nearby offsite Well-E (about 800 feet from Well-12) is about 3.3 feet. Based on the representative aquifer parameters, the saturated depth of water above the pump intake, and County guidance for determination of significance (predicted 5-year drawdown in offsite wells shall not exceed 20 feet for fractured rock wells) on-site pumping should not pose a significant impact to offsite wells.
- Water quality in Well-12 is regulated under the County Small Water System guidelines and meets the relevant drinking water standards for the parameters listed herein; hence groundwater quality is not anticipated to be a significant impact for the project.

5.1 Recommendations

- We recommend that any change in use of onsite production wells be located as far as possible and upgradient of septic systems and other sources of contamination.
- We recommend that any new septic systems be located as far as possible and down gradient (where practicable) of groundwater production wells.
- Since open wells could provide a conduit for groundwater contamination and could present a safety hazard, existing (and any future) onsite wells should be secured with locking covers. Wells which will not be used in the future should be properly abandoned.
- We recommend that a Groundwater Monitoring and Management Plan (GMMP) be implemented per County of San Diego Groundwater Ordinance (9826 N.S.). A County-Groundwater-Geologist-approved GMMP for Freedom Ranch is attached in Appendix E.

6.0 REFERENCES

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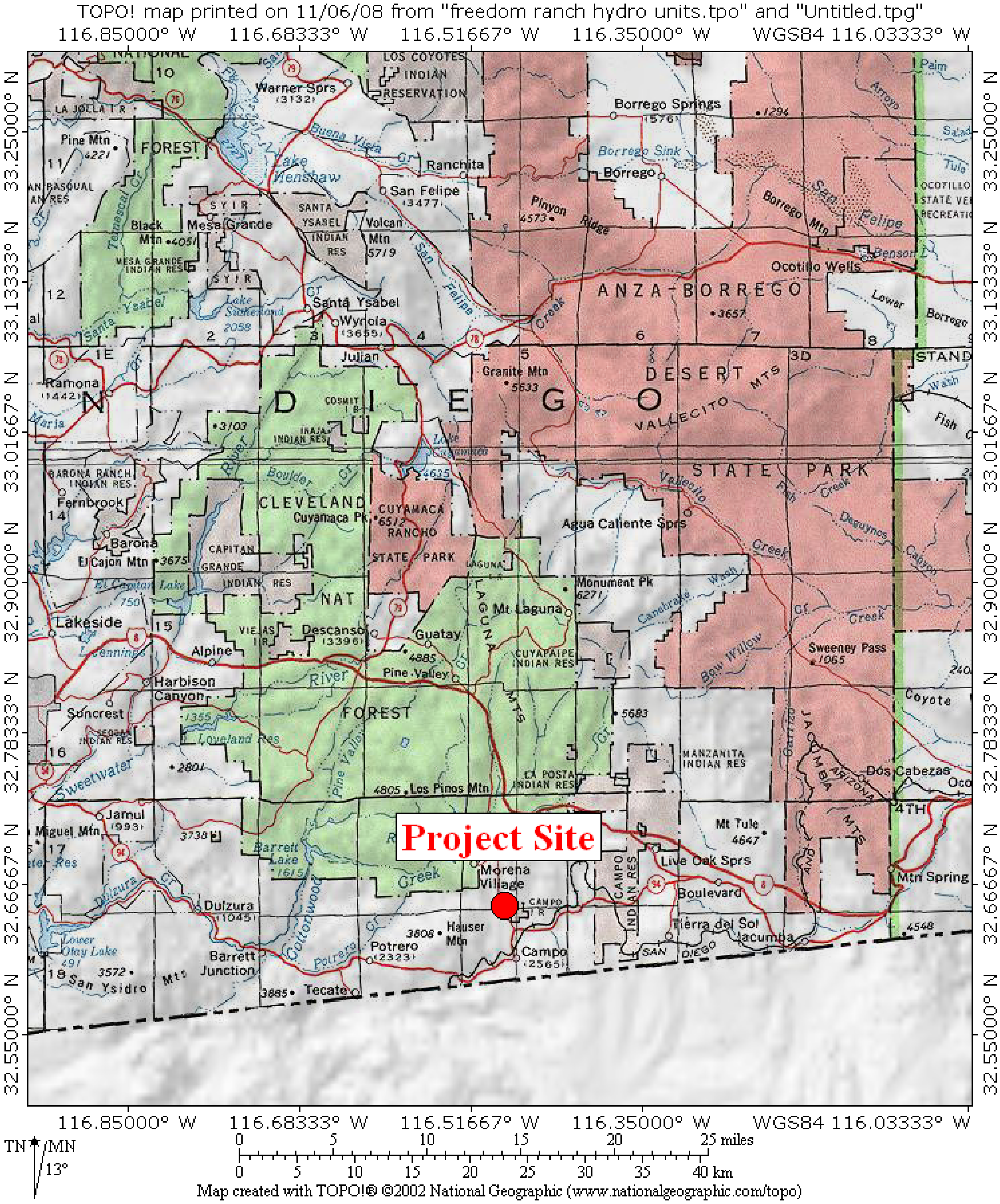
15. United States Geological Survey. 1959a. Cameron Corners Quadrangle. San Diego County, California. Scale 1:24,000.
16. United States Geological Survey. 1959b. Cameron Corners Quadrangle. San Diego County, California. Scale 1:24,000.
17. Wiedlin & Associates, Inc. January 2006. Hydrogeologic Investigation – A Children’s Village, Campo, CA.

FIGURES

1. Regional Location Map



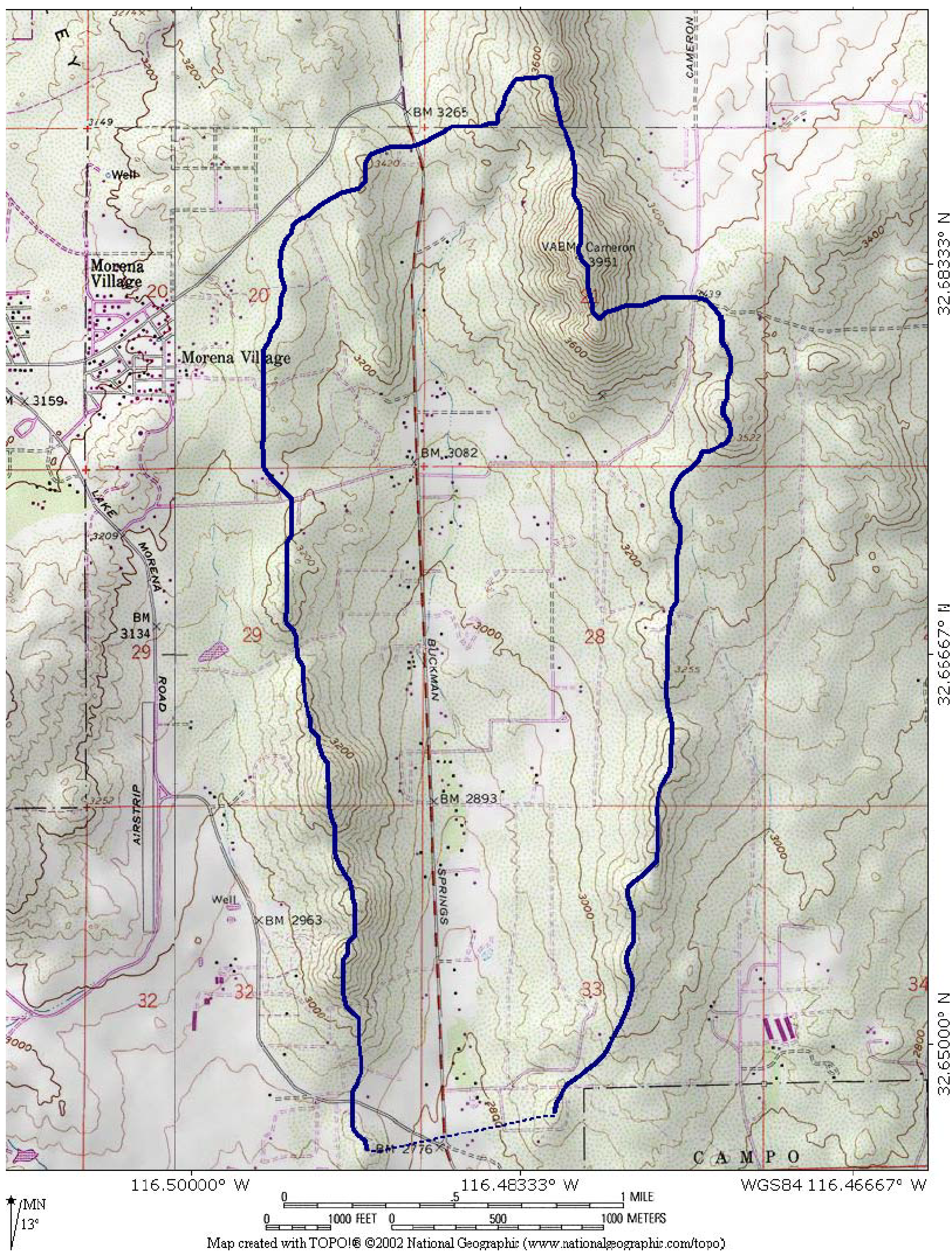
Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)

Figure 1
REGIONAL LOCATION MAP
Freedom Ranch
San Diego County, California
June 2013

Project No. 60246607

AECOM

2. Watershed Boundary Map



🟦 Watershed Boundary

Figure 2
WATERSHED BOUNDARY
Freedom Ranch
San Diego County, California
June 2013
Project No. 60246607

AECOM

Source: TOPO!Map Created from www.nationalgeographic.com/topo

3. Precipitation Map

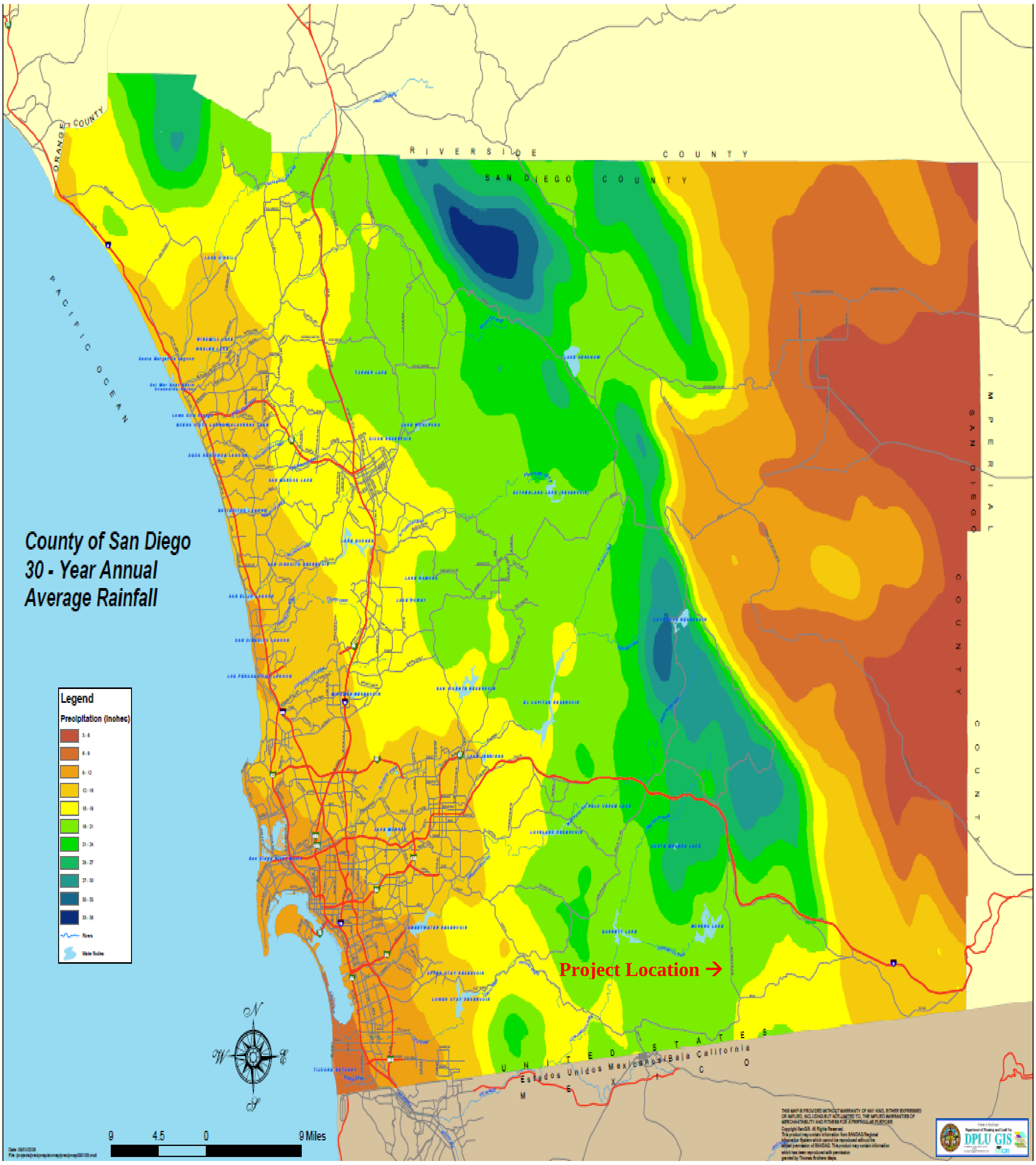


Figure 3
PRECIPITATION MAP
Freedom Ranch
San Diego County, California
June 2013
Project No. 60246607

AECOM

Source: County of San Diego Department of Public Land Use (DPLU) San GIS

4. General Plan Land Use Map

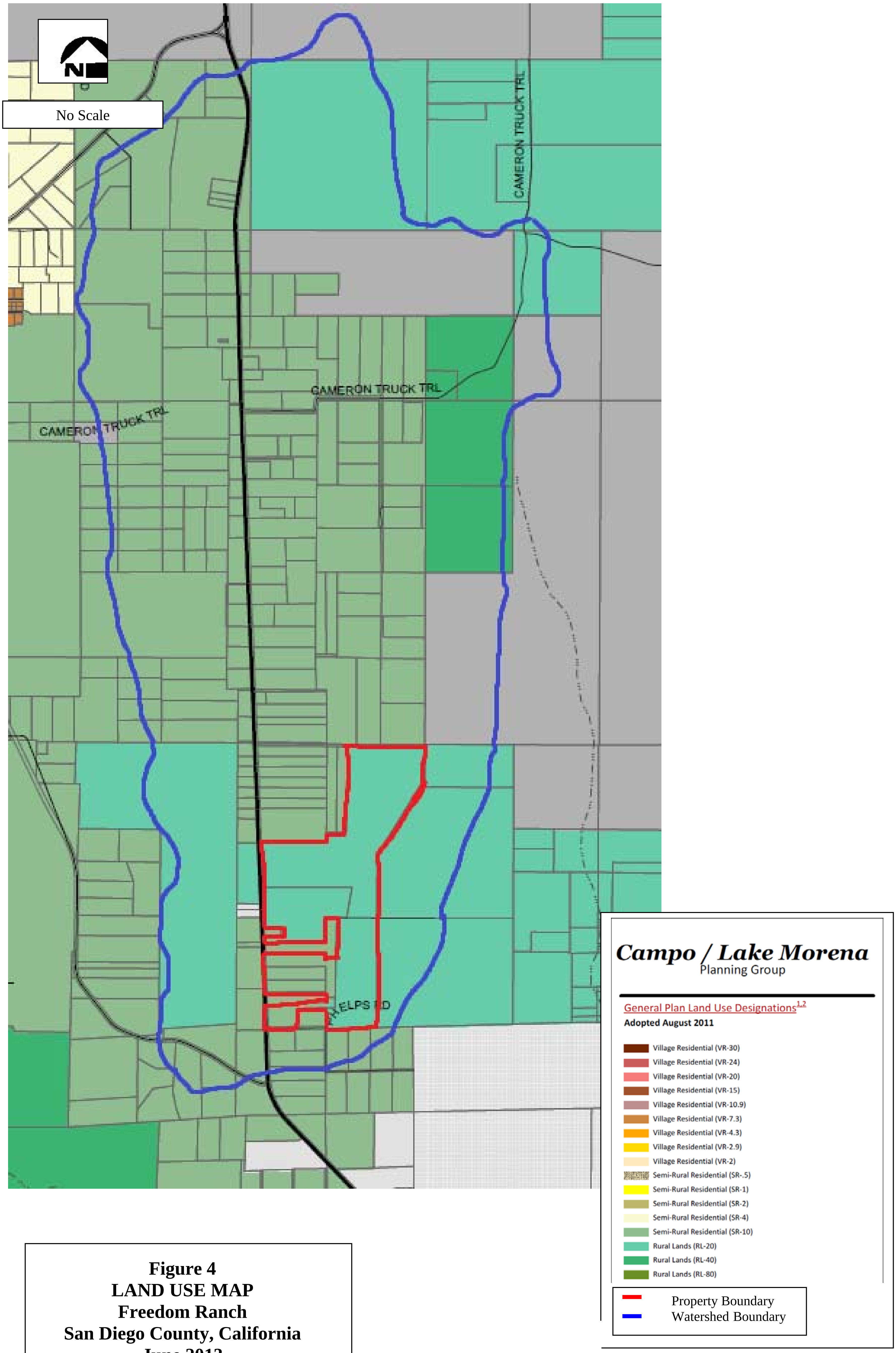
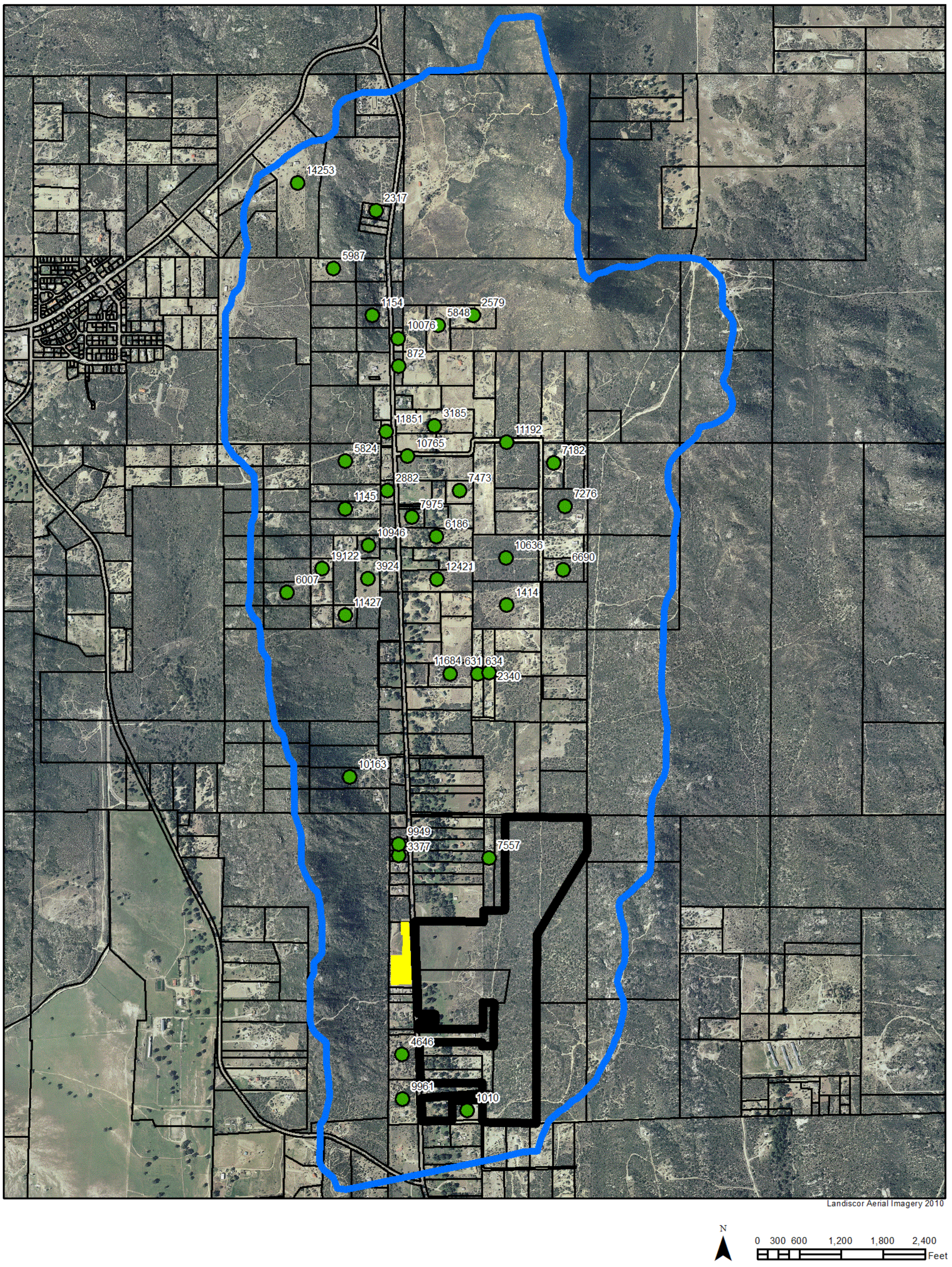


Figure 4
LAND USE MAP
Freedom Ranch
San Diego County, California
June 2013
Project No. 60246607

Source:County of San Diego. 2011. Lake Morena/Campo General Plan Map. San Diego County, California.

5. Offsite Wells and Vineyard

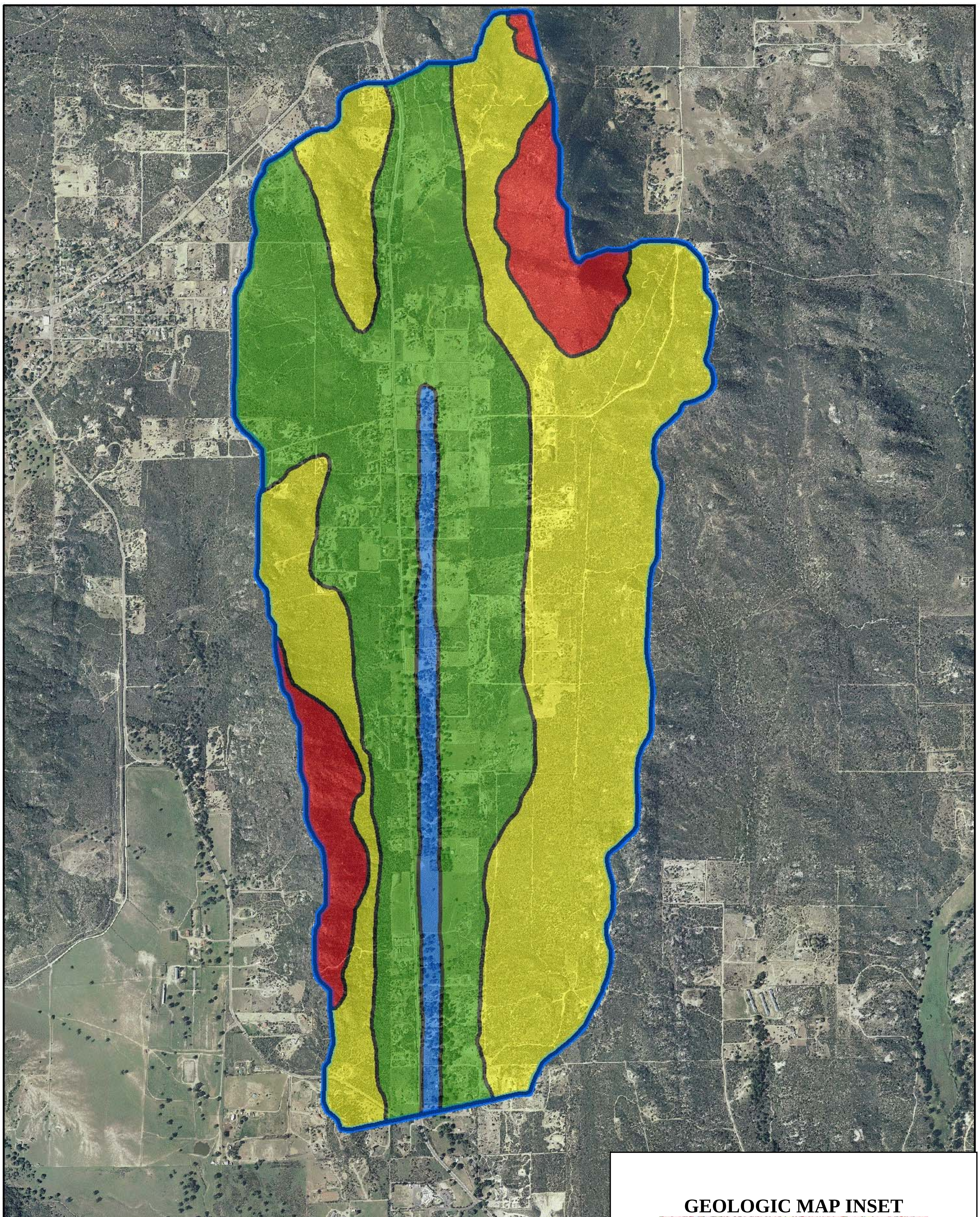


━ Watershed Boundary
━ Project Boundary
🟨 Offsite Vineyard
● Well Completion Report Reviewed

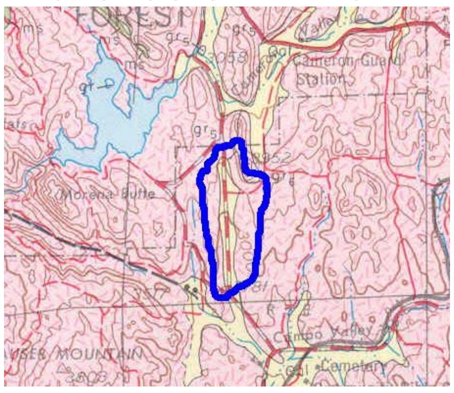
Figure 5
OFFSITE WELLS AND VINEYARD
Freedom Ranch
Campo, San Diego County, California
June 2013
Project No. 60246607

AECOM

6. Hydrogeologic Units Map



GEOLOGIC MAP INSET



Inset Source: CDMG Geologic Map of California 1962.

Alluvium
Granitic Rocks

N ⬆

▬ Watershed Boundary
🟦 Alluvium
🟩 Saturated Residuum
🟥 Fractured Bedrock > 25% Slopes
🟨 Fractured Bedrock <= 25% Slopes

Figure 6
HYDROGEOLOGIC UNITS MAP
Freedom Ranch
Campo, San Diego County, California
June 2013
Project No. 60246607

AECOM

7. Soils Map

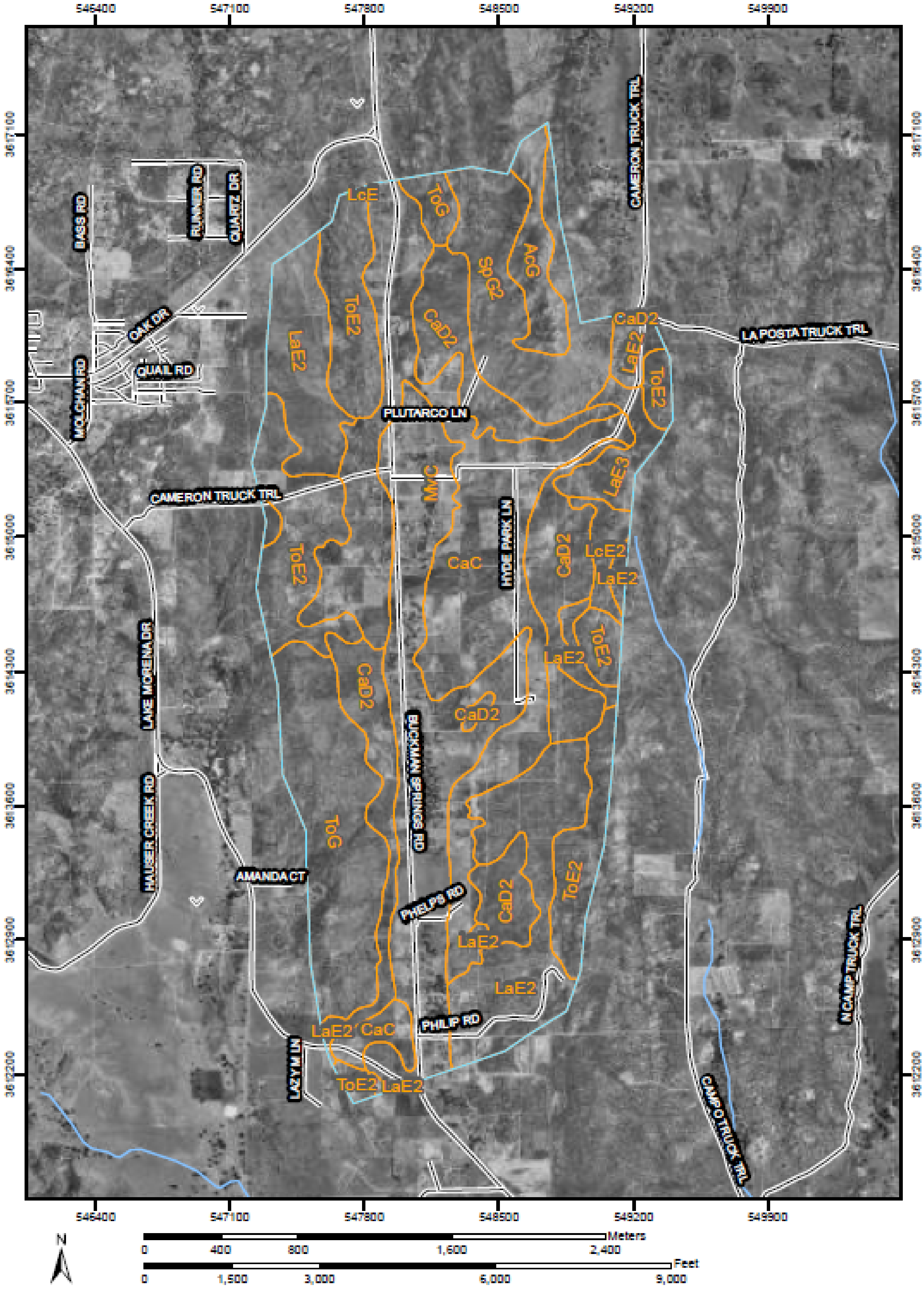


Figure 7
USDA SOILS MAP
Freedom Ranch
San Diego County, California
June 2013
Project No. 60246607

AECOM

Source: USDA Natural Resources Conservation Service – Web Soil Survey 2.0

8. Well Interference Map – Predicted 5-Year Drawdown

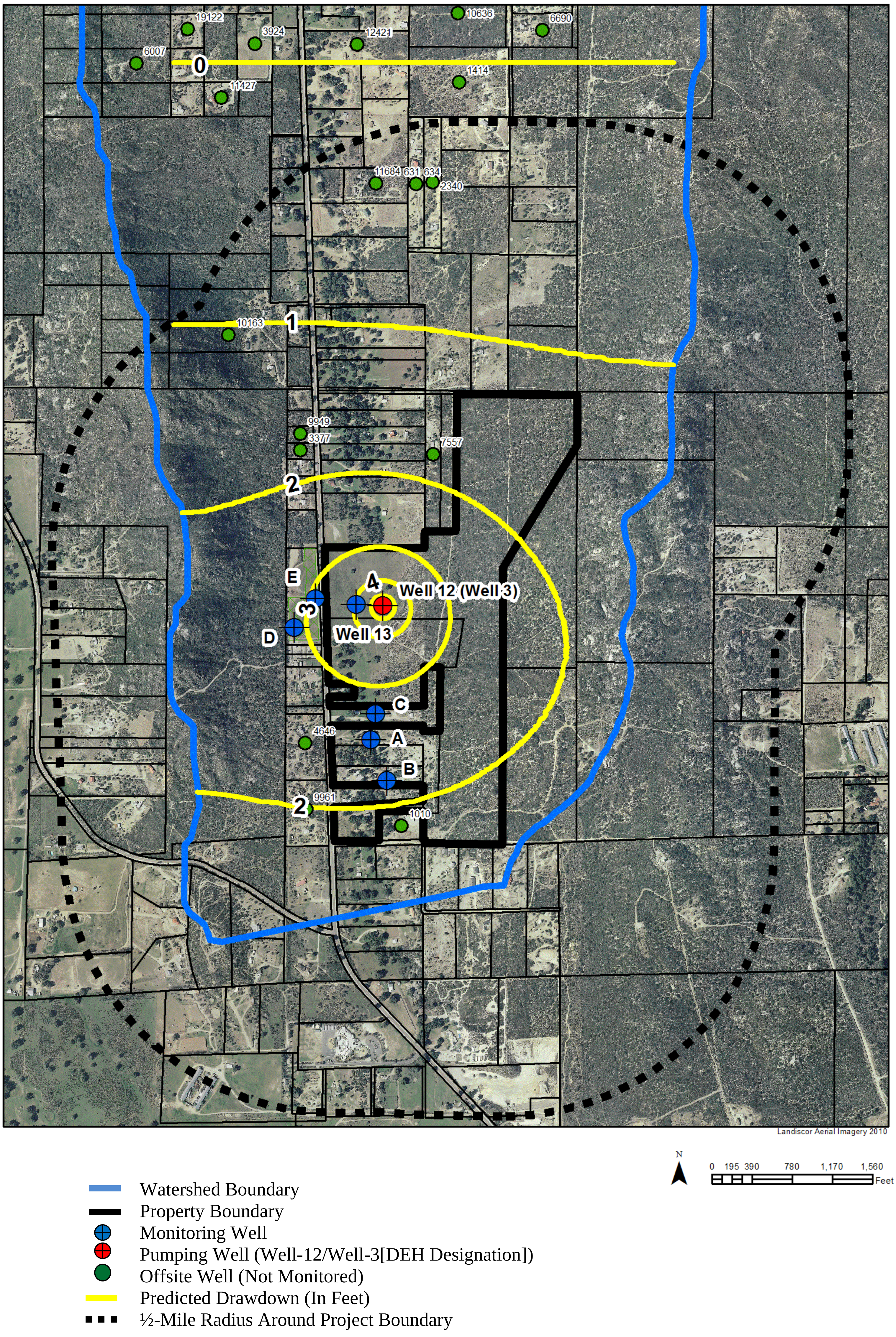


Figure 8
PREDICTED 5-YEAR DRAWDOWN
Freedom Ranch
San Diego County, California
June 2013
Project No. 60246607

Source: County of San Diego Department of Public Land Use (DPLU) San GIS

TECHNICAL APPENDICES/ATTACHMENTS

A. Rainfall Data

Appendix A - Freedom Ranch Rainfall Prorated from Lake Morena Data

Year	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	**Total**	Prorated
1967	0.10	1.20	0.70	0.00	14.70	5.10	0.50	0.70	2.00	1.20	0.40	0.10	26.70	25.02
1968	0.70	0.20	0.00	0.10	1.00	1.70	9.40	4.50	2.20	0.30	0.40	0.20	20.70	19.40
1969	0.00	0.00	0.20	0.00	2.00	0.50	0.50	2.40	3.70	1.30	0.00	0.00	10.60	9.93
1970	0.00	0.00	0.00	0.10	2.70	4.20	1.80	1.80	0.60	2.20	1.30	0.00	14.70	13.77
1971	0.22	2.89	0.31	1.22	0.04	3.67	0.00	0.07	0.00	0.20	0.11	1.03	9.75	9.14
1972	0.00	0.00	0.20	2.30	3.40	2.30	2.30	4.50	7.70	0.60	0.30	0.10	23.70	22.21
1973	0.10	0.10	0.00	0.00	2.60	0.30	5.50	0.40	1.60	0.60	0.10	0.00	11.30	10.59
1974	0.70	0.00	0.40	3.40	0.50	1.80	0.50	1.70	5.20	3.40	0.50	0.30	18.40	17.24
1975	0.00	0.00	1.30	1.50	2.90	1.50	0.10	8.30	2.00	2.50	3.00	0.00	23.10	21.65
1976	0.50	0.00	3.20	0.50	1.30	1.00	3.10	1.00	3.30	0.40	2.10	0.00	16.40	15.37
1977	0.20	1.40	0.00	0.90	0.40	4.70	9.50	8.30	9.10	2.10	0.50	0.00	37.10	34.76
1978	0.00	0.00	0.40	0.00	4.60	5.50	6.10	3.00	7.80	0.10	0.40	0.00	27.90	26.14
1979	0.00	0.20	0.20	1.30	0.50	1.00	17.10	13.20	4.20	2.40	1.30	0.00	41.40	38.79
1980	0.10	0.30	0.00	0.40	0.50	1.10	1.60	3.60	5.90	1.00	0.30	0.00	14.80	13.87
1981	0.00	0.20	0.00	0.40	2.20	1.10	6.40	3.50	7.90	0.50	0.30	0.00	22.50	21.08
1982	0.20	1.00	1.40	0.30	6.30	2.80	3.30	7.70	10.20	3.20	0.40	0.30	37.10	34.76
1983	0.20	2.60	0.60	0.80	2.20	0.13	0.37	0.10	0.20	0.40	0.00	0.10	7.70	7.22
1984	2.50	1.10	0.20	0.20	1.80	4.00	1.60	2.20	2.00	0.60	0.10	0.00	16.30	15.27
1985	0.00	0.00	0.40	1.00	6.00	2.20	0.90	4.70	5.00	0.30	0.00	0.00	20.50	19.21
1986	0.00	1.10	1.50	2.10	0.83	1.06	2.60	2.80	2.50	0.50	0.00	0.00	14.99	14.05
1987	0.00	1.00	1.50	4.20	3.20	2.80	3.60	2.40	0.60	2.80	0.20	0.00	22.30	20.90
1988	0.10	0.70	0.30	0.10	0.50	3.00	1.00	1.60	2.40	0.10	0.20	0.00	10.00	9.37
1989	0.00	0.00	0.20	0.50	0.10	0.20	4.30	2.20	0.20	1.10	0.70	0.49	9.99	9.36
1990	0.00	0.20	0.90	0.00	0.70	1.70	1.10	5.00	11.70	0.20	0.00	0.00	21.50	20.15
1991	0.60	0.00	0.20	0.90	0.00	0.00	0.10	5.60	4.99	0.00	0.20	0.00	12.59	11.80
1992	0.20	2.20	0.70	0.30	0.10	2.00	12.90	7.20	1.80	0.00	0.10	0.30	27.80	26.05
1993	0.00	0.26	0.00	0.54	1.39	1.31	2.01	5.75	4.08	2.89	0.09	0.00	18.32	17.17
1994	0.00	1.80	0.00	0.00	0.80	1.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	3.37
1995	0.07	0.13	0.47	0.00	0.13	1.23	2.09	4.14	2.88	0.62	0.17	0.00	11.93	11.18
1996	0.37	0.05	0.00	1.61	2.97	2.95	7.85	2.36	0.26	0.21	0.02	0.49	19.14	17.94
1997	0.04	0.17	2.17	0.16	2.56	4.73	3.10	14.85	5.57	3.84	1.97	0.18	39.34	36.86
1998	0.37	1.25	0.42	0.08	2.25	2.20	2.56	1.48	1.32	4.94	0.20	0.68	17.75	16.63
1999	0.24	0.00	0.42	0.00	0.07	0.32	1.40	5.56	1.74	0.82	0.00	0.18	10.75	10.07
2000	0.00	0.09	0.56	1.05	0.56	0.17	4.31	4.88	1.98	2.53	0.00	0.00	16.13	15.11
2001	0.05	0.11	0.32	0.00	1.41	1.84	0.59	0.32	2.06	0.90	0.00	0.00	7.60	7.12
2002	0.01	1.01	1.01	0.18	1.06	3.10	0.20	5.17	3.33	1.93	1.16	0.00	18.16	17.02
2003	0.55	2.05	0.15	0.00	1.02	3.09	1.00	6.02	0.76	1.42	0.00	0.00	16.06	15.05
2004	0.22	0.00	0.00	10.48	1.55	6.22	6.25	6.59	1.74	1.00	0.03	0.00	34.08	31.93
2005	0.87	1.10	0.04	1.26	0.08	0.24	1.54	2.83	5.04	5.35	0.31	0.00	18.66	17.49
2006	0.59	0.04	0.04	0.35	0.24	2.32	1.61	4.65	0.31	0.87	0.00	0.00	11.02	10.33
2007	0.00	0.12	0.55	0.35	2.40	2.28	12.52	5.20	0.91	0.00	0.63	0.24	25.20	23.61

B. Analytical Data Well-12 (Small Water System Well 3)

EnviroMatrix **Analytical, Inc.**

14 March 2012

Stephen E. Carroll
Attn: Stephen Carroll
PO Box 1096
Pine Valley, CA 91962-1096

EMA Log #: 12C0182

Project Name: FREEDOM RANCH
Project Desc./#: PS 3700063

Enclosed are the results of analyses for samples received by the laboratory on 03/08/12 12:07. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

Client Name: Stephen E. Carroll

Project Name: FREEDOM RANCH

EMA Log #: 12C0182

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
3700063-DIST	12C0182-01	Drinking Water	03/08/12 10:22	03/08/12 12:07

Client Name: Stephen E. Carroll
Project Name: FREEDOM RANCH

EMA Log #: 12C0182

Microbiological Parameters by Standard Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Date Prepared Date Analyzed	Method	Notes
3700063-DIST (12C0182-01) Drinking Water Sampled: 03/08/12 10:22 Received: 03/08/12 12:07								
Total Coliforms	Absent		None	1	2030907	03/08/12 13:22 03/09/12 14:06	SM9223	
E. Coli	Absent		"	"	"	03/08/12 13:22 03/09/12 14:06	"	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Notes and Definitions

ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
RPD	Relative Percent Difference

Page 1 of 1

– EnviroMatrix Analytical, Inc. —

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

MAR 8 '12 12:12

CHAIN-OF-CUSTODY RECORD

EMA LOG #: 1200182
Client: STEPHEN E CARROLL
Attn: STEVE
Samplers(s): SE CARROLL
Address: PO BOX 1096
P V Ca 91962
Phone: 619-916-6989 Fax: 619-473-8233
Email: stephen-carroll@sbcglobal.net
Billing Address: SAME
Project ID: FREEDOM RANCH
Project #: 3700063 PO #:

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	3700063 - DIST	3/8/12	1022	DW	1/3
2					
3					
4					
5					
6					
7					
8					
9					
10					

Requested Analysis

MAR 8 '12 12:12

ID #	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015B (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☒ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide					
1		SPECIAL SAMPLE													X								
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☐ Courier ☐ UPS ☐ FedEx ☐ USPS ☒ Client Drop Off ☐ Other
[1]Turn-Around-Time: ☐ Same Day ☐ 24 hr ☐ 48 hr ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
[1]Reporting Requirements: ☐ Fax ☒ PDF ☐ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
[1]Sample Disposal: ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: Yes No N/A	Containers Properly Preseved: Yes No N/A
Custody Seals Intact: Yes No N/A	Temp @ Receipt:________
COC/Labels Agree: Yes No N/A	Sampled By: Client EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature	3/8/11 1207	Signature
Print SE CARROLL		Print M. [illegible]
Company: STEPHEN carroll		Company: EMA
Signature		Signature
Print		Print
Company:		Company:
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments: No Cl2 Special Sample Coliform

3° ICE

[1]Additional costs may apply, consult a project manager for details.

[2]EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

EnviroMatrix Analytical, Inc.

02 April 2012

Stephen E. Carroll
Attn: Stephen Carroll
PO Box 1096
Pine Valley, CA 91962-1096

EMA Log #: 12C0550

Project Name: FREEDOM RANCH
Project Desc./#:PS 3700063

Enclosed are the results of analyses for samples received by the laboratory on 03/23/12 11:47. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

Client Name: Stephen E. Carroll
Project Name: FREEDOM RANCH

EMA Log #: 12C0550

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
3700063-DIST	12C0550-01	Drinking Water	03/23/12 10:45	03/23/12 11:47
3700063-003	12C0550-02	Drinking Water	03/23/12 10:45	03/23/12 11:47

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: Stephen E. Carroll
Project Name: FREEDOM RANCH

EMA Log #: 12C0550

Conventional Chemistry Parameters by Standard/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
3700063-003 (12C0550-02) Drinking Water	**Sampled: 03/23/12 10:45**		**Received: 03/23/12 11:47**						
Nitrate as N	**0.38**	0.10	mg/l	2	2032822	03/28/12	03/28/12	SM4500 NO3 E	W-02
Nitrate as NO3	**1.66**	0.44	"	"	"	"	"	Calc/Conversion	W-02

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: Stephen E. Carroll
Project Name: FREEDOM RANCH

EMA Log #: 12C0550

Microbiological Parameters by Standard Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
3700063-DIST (12C0550-01) Drinking Water Sampled: 03/23/12 10:45 Received: 03/23/12 11:47									
Total Coliforms	Absent		None	1	2032615	03/23/12	03/24/12	SM9223	
E. Coli	Absent		"	"	"	"	"	"	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: Stephen E. Carroll **EMA Log #: 12C0550**
Project Name: FREEDOM RANCH

Conventional Chemistry Parameters by Standard/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2032822										
Blank (2032822-BLK1)				Prepared: 03/28/12 Analyzed: 03/30/12						
Nitrate as NO3	ND	0.22	mg/l							
Nitrate as N	ND	0.05	"							
LCS (2032822-BS1)				Prepared & Analyzed: 03/28/12						
Nitrate as N	0.50	0.05	mg/l	0.500		100	80-120			
LCS Dup (2032822-BSD1)				Prepared & Analyzed: 03/28/12						
Nitrate as N	0.50	0.05	mg/l	0.500		100	80-120	0.8	20	
Duplicate (2032822-DUP1)		**Source: 12C0403-04**		Prepared: 03/28/12 Analyzed: 03/30/12						
Nitrate as NO3	ND	0.22	mg/l		ND				20	
Nitrate as N	1.58	0.50	"		1.62			2	20	
Matrix Spike (2032822-MS1)		**Source: 12C0403-04**		Prepared & Analyzed: 03/28/12						
Nitrate as N	6.35	0.50	mg/l	5.00	1.62	95	80-120			
Matrix Spike Dup (2032822-MSD1)		**Source: 12C0403-04**		Prepared & Analyzed: 03/28/12						
Nitrate as N	5.98	0.50	mg/l	5.00	1.62	87	80-120	6	20	
Reference (2032822-SRM1)				Prepared & Analyzed: 03/28/12						
Nitrate as N	8.22	1.25	mg/l	4.34		189	0-200			

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Notes and Definitions

W-02	The sample for nitrate analysis was preserved with H_2SO_4 after the nitrite portion of the analysis was completed to extend the holding time for the sample. Nitrate results are corrected for the nitrite contribution per the method.
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

CHAIN-OF-CUSTODY RECORD

– EnviroMatrix Analytical, Inc. ——

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

MAR 23 '12 11:46 Page 1 of 1

EMA LOG #: 1203550
Client: STEPHEN E. CARROll
Attn: STEVE
Samplers(s): SE CARROLL
Address: POB 1096
PV, CA 91962
Phone: 619-916-6989 Fax: 619-473-9233
Email: stephen-carroll@sbcglobal.net
Billing Address: SAME
Project ID: FREEDOM RANCH
Project #: 3700063 PO #:

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type
1	3700063 - DIST	3/23/12	1045	DW	1/S
2	3700063 - 003	3/23/12	1045	1	1/P
3					
4					
5					
6					
7					
8					
9					
10					

Requested Analysis

ID #	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015B (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐ TDS	☒ Nitrate ☐ Nitrite ☐ TKN ☐ NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☒ P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide					
1															X								
2										X													
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☐ Courier ☐ UPS ☐ FedEx ☐ USPS ☒ Client Drop Off ☐ Other
[1]Turn-Around-Time: ☐ Same Day ☐ 24 hr ☐ 48 hr ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
[1]Reporting Requirements: ☐ Fax ☒ PDF ☐ Excel ☐ Geotracker/EDF ☐ Hard Copy ☒ EDT
[1]Sample Disposal: ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: Yes No N/A	Containers Properly Preseved: Yes No N/A
Custody Seals Intact: Yes No N/A	Temp @ Receipt: 5c TW
COC/Labels Agree: Yes No N/A	Sampled By: Client EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature SE Carroll	3/23/12 1147	Signature
Print SE CARROLL		Print A. Fallas
Company: STEPHEN CARROLL		Company: EMA
Signature		Signature
Print		Print
Company:		Company:
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments: NO Cl2

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[1] Additional costs may apply, consult a project manager for details.

[2] EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

EnviroMatrix EMA Analytical, Inc.

13 December 2012

Stephen E. Carroll
Attn: Stephen Carroll
PO Box 1096
Pine Valley, CA 91962-1096

EMA Log #: 12L0087

Project Name: FREEDOM RANCH
Project Desc./#: PS 3700063

Enclosed are the results of analyses for samples received by the laboratory on 12/04/12 13:05. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564

4340 Viewridge Avenue, Suite A - San Diego, California 92123 - (858) 560-7717 - Fax (858) 560-7763
Analytical Chemistry Laboratory

Client Name: Stephen E. Carroll

Project Name: FREEDOM RANCH

EMA Log #: 12L0087

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
3700063 - DST	12L0087-01	Drinking Water	12/04/12 10:45	12/04/12 13:05

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: Stephen E. Carroll **EMA Log #: 12L0087**

Project Name: FREEDOM RANCH

Microbiological Parameters by Standard Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Date Prepared Date Analyzed	Method	Notes
3700063 - DST (12L0087-01) Drinking Water Sampled: 12/04/12 10:45 Received: 12/04/12 13:05								
Total Coliforms	Absent		None	1	2120453	12/04/12 13:25 12/05/12 13:25	SM9223	
E. Coli	Absent		"	"	"	12/04/12 13:25 12/05/12 13:25	"	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Notes and Definitions

ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
RPD	Relative Percent Difference

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

CHAIN-OF-CUSTODY RECORD

– EnviroMatrix Analytical, Inc. ——

4340 Viewridge Ave., Ste. A - San Diego, CA 92123 - Phone (858) 560-7717 - Fax (858) 560-7763

Page 1 of 1

DEC 4'12 13:10

EMA LOG #: 12L0087

Client: STEPHEN E. CARROLL
Attn: STEVE
Samplers(s): SE CARROLL
Address: PO BOX 1096
PV, Ca 91962
Phone: 619-916-6989 Fax: 619-473 8233
Email: stephen-carroll@sbcglobal.net
Billing Address: SAME

Project ID: FREEDOM RANCH
Project #: 3700063 PO #:

Requested Analysis

ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container # / Type	Oil & Grease ☐ 413.1 ☐ 413.2 ☐ 1664	8015 (TPH) ☐ Gas ☐ Diesel ☐ Ext	624/8260 (VOC) Full BTXE MTBE Oxy Nap	625 / 8270 (SVOC) ☐ PAH only	608 / 8081 (Organochlorine Pesticides)	608 / 8082 (Polychlorinated Biphenyls)	8141 (Organophosphorus Pesticides)	TBT (Organotin Compounds)	☐ pH ☐ EC ☐ TSS ☐TDS	☐ Nitrate ☐ Nitrite ☐ TKN ☐NH3	CAC Title 22/CAM17 Metals ☐ TTLC ☐ STLC	TCLP (RCRA) ☐ Metals ☐ Organics	Cd Cr Cu Pb Ni Ag Zn ☐ Dissolved	Coliform, ☐ Total (MTF) ☐ Fecal (MTF)	Colilert, T+E.Coli ☒P/A ☐ Enumeration	Enterococcus, ☐ MTF ☐ Enterolert	Heterotrophic Plate Count (HPC)	☐ BOD ☐ COD ☐ Cyanide						
1	3700063 -DST	12/4/12	1045	DW	1/S															X									
2																													
3																													
4																													
5																													
6																													
7																													
8																													
9																													
10																													

Matrix Codes: A = Air, DW = Drinking Water, GW = Groundwater, SW = Storm Water
WW = Wastewater, S = Soil, SED = Sediment, SD = Solid, T = Tissue, O = Oil, L = Liquid
Shipped By: ☐ Courier ☐ UPS ☐ FedEx ☐ USPS ☒ Client Drop Off ☐ Other
[1]Turn-Around-Time: ☐ Same Day ☐ 1 day ☐ 2 day ☐ 3 day ☐ 4 day ☐ 5 day ☒ STD (7 day)
[1]Reporting Requirements: ☐ Fax ☒ PDF ☐ Excel ☐ Geotracker/EDF ☐ Hard Copy ☐ EDT
[1]Sample Disposal: ☒ By Laboratory ☐ [2]Return to Client: P/U or Delivery ☐ Archive

Sample Integrity

Correct Containers: Yes No N/A	Containers Properly Preseved: Yes No N/A
Custody Seals Intact: Yes No N/A	Temp @ Receipt:__________
COC/Labels Agree: Yes No N/A	Sampled By: Client EMA Autosampler

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature	12/4/12	Signature
Print SE CARROLL		Print Lisa Seeman
Company: STEPHEN CARROLL		Company: Stephen Carroll
Signature	12/4/12 1305	Signature
Print Lisa Seeman		Print DAVID Nguyen
Company: Stephen Carroll		Company: EMA
Signature		Signature
Print		Print
Company:		Company:

Project/Sample Comments: CL_2 = None

3°C
on Ice

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[1]Additional costs may apply. Please note there is a $35 minimum charge for all clients.

[2]EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.

C. Recharg2 Output

Recharg2 Output
Flatter Areas

Soil Moisture Capacity = 5.10
Calculated Average Recharge = 1.77
Assumed maximum runoff = 20.00 Percent.
Calculated average runoff = 6.09 Percent.

Year	Total Rainfall	Calculated Runoff	Calculated Recharge
1967	15.17	0.80	0.00
1968	19.64	2.03	2.20
1969	10.05	0.00	0.00
1970	13.95	0.51	0.00
1971	9.26	0.20	0.00
1972	22.48	1.86	0.12
1973	10.71	0.58	0.00
1974	17.45	0.26	0.00
1975	21.91	1.12	0.00
1976	15.55	0.12	0.00
1977	35.21	5.25	10.33
1978	26.49	4.02	4.37
1979	39.31	5.11	15.40
1980	14.03	0.65	0.00
1981	21.35	2.55	1.46
1982	35.22	4.91	6.94
1983	7.30	0.00	0.00
1984	15.47	0.49	0.00
1985	19.46	1.96	0.00
1986	14.22	0.16	0.00
1987	21.18	0.71	0.00
1988	9.47	0.13	0.00
1989	9.47	0.44	0.00
1990	20.40	1.93	2.76
1991	11.95	0.89	0.00
1992	26.38	2.84	7.40
1993	17.41	1.01	0.00
1994	3.42	0.00	0.00
1995	11.34	0.30	0.00
1996	18.19	1.47	0.87
1997	37.36	4.70	8.05
1998	16.87	0.12	0.00
1999	10.21	0.58	0.00
2000	15.32	1.06	0.00
2001	7.21	0.00	0.00
2002	17.24	0.74	0.00
2003	15.26	0.78	0.00
2004	32.38	4.78	6.77
2005	17.73	0.40	0.00
2006	10.47	0.34	0.00
2007	23.93	2.39	5.75

Freedom Ranch Groundwater Investigation – Appendix C

Recharg2 Output
Mid Slope Areas

Soil Moisture Capacity = 2.00
Calculated Average Recharge = 2.56
Assumed maximum runoff = 25.00 Percent.
Calculated average runoff = 9.39 Percent.

Year	Total Rainfall	Calculated Runoff	Calculated Recharge
1967	15.17	1.22	1.18
1968	19.64	2.45	4.87
1969	10.05	0.00	0.00
1970	13.95	0.98	0.00
1971	9.26	0.39	0.00
1972	22.48	3.23	1.85
1973	10.71	0.70	0.82
1974	17.45	0.63	0.00
1975	21.91	1.26	2.49
1976	15.55	0.34	0.00
1977	35.21	7.19	11.52
1978	26.49	5.41	6.08
1979	39.31	6.15	17.47
1980	14.03	1.34	0.00
1981	21.35	3.52	3.59
1982	35.22	6.82	8.17
1983	7.30	0.00	0.00
1984	15.47	0.96	0.00
1985	19.46	3.29	0.51
1986	14.22	0.43	0.00
1987	21.18	1.52	0.00
1988	9.47	0.33	0.00
1989	9.47	0.84	0.00
1990	20.40	3.23	4.57
1991	11.95	1.80	0.26
1992	26.38	3.61	9.74
1993	17.41	1.72	0.47
1994	3.42	0.00	0.00
1995	11.34	0.79	0.00
1996	18.19	2.16	3.27
1997	37.36	6.61	9.14
1998	16.87	0.36	0.00
1999	10.21	0.87	0.22
2000	15.32	1.86	0.96
2001	7.21	0.00	0.00
2002	17.24	1.46	0.00
2003	15.26	1.21	0.64
2004	32.38	5.67	8.95
2005	17.73	0.87	0.00
2006	10.47	0.75	0.00
2007	23.93	3.20	8.06

Freedom Ranch Groundwater Investigation – Appendix C

Recharg2 Output
Steeper Areas

Soil Moisture Capacity = 1.70
Calculated Average Recharge = 2.40
Assumed maximum runoff = 30.00 Percent.
Calculated average runoff = 11.27 Percent.

Year	Total Rainfall	Calculated Runoff	Calculated Recharge
1967	15.17	1.50	1.21
1968	19.64	2.93	4.73
1969	10.05	0.00	0.00
1970	13.95	1.19	0.00
1971	9.26	0.52	0.00
1972	22.48	3.92	1.48
1973	10.71	0.84	0.99
1974	17.45	0.77	0.00
1975	21.91	1.51	2.60
1976	15.55	0.47	0.00
1977	35.21	8.63	10.43
1978	26.49	6.46	5.33
1979	39.31	7.26	16.73
1980	14.03	1.65	0.00
1981	21.35	4.17	3.26
1982	35.22	8.19	7.18
1983	7.30	0.00	0.00
1984	15.47	1.13	0.00
1985	19.46	3.70	0.53
1986	14.22	0.56	0.00
1987	21.18	1.76	0.10
1988	9.47	0.45	0.00
1989	9.47	1.00	0.02
1990	20.40	4.01	4.09
1991	11.95	2.05	0.42
1992	26.38	4.36	9.34
1993	17.41	1.95	0.61
1994	3.42	0.00	0.00
1995	11.34	0.97	0.00
1996	18.19	2.60	3.17
1997	37.36	7.92	8.21
1998	16.87	0.43	0.00
1999	10.21	1.04	0.39
2000	15.32	2.29	0.87
2001	7.21	0.00	0.00
2002	17.24	1.76	0.07
2003	15.26	1.46	0.76
2004	32.38	6.68	8.28
2005	17.73	1.02	0.00
2006	10.47	0.92	0.00
2007	23.93	3.88	7.70

D. Groundwater in Storage Calculations

Current Project and Basin Buildout
Groundwater in Storage
1,940-Acre Freedom Ranch Watershed

Maximum storage	2474.2	acre-feet
One half	1237.1	acre-feet
Minimum calculated	2,192.4	acre-feet

Rock Type	Saturated b	Area	S	Total in storage
Fractured Rock (Flat)	500	1727	0.001	863.5
Fractured Rock (Slopes)	500	213	0.0001	10.7
DG	35	910	0.05	1592.5
Alluvium	10	15	0.05	7.5

										Total Groundwater in Storage		2474.2
Year	Beginning Storage (af)	Total Rainfall (inches)	Recharge Flatter Elevations (inches/year)	Recharge Mid-Slope Elevations (inches/year)	Recharge Steeper Elevations (inches/year)	Recharge Flatter Elevations (afy)	Recharge Mid-Slope Elevations (afy)	Recharge Steeper Elevations (afy)	Total Recharge (afy)	Offiste Extraction (afy)	Onsite Extraction (afy)	Ending Storage (af)
1967-1968	2474.2	15.17	0	1.18	1.21	0.0	76.3	21.5	97.8	42.2	4.4	2,474.2
1968-1969	2474.2	19.64	2.2	4.87	4.73	174.5	314.9	84.0	573.4	42.2	4.4	2,474.2
1969-1970	2474.2	10.05	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,427.5
1970-1971	2427.5	13.95	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,380.9
1971-1972	2380.9	9.26	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,334.3
1972-1973	2334.3	22.48	0.12	1.85	1.48	9.5	119.6	26.3	155.4	42.2	4.4	2,443.1
1973-1974	2443.1	10.71	0	0.82	0.99	0.0	53.0	17.6	70.6	42.2	4.4	2,467.1
1974-1975	2467.1	17.45	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,420.5
1975-1976	2420.5	21.91	0	2.49	2.6	0.0	161.0	46.2	207.2	42.2	4.4	2,474.2
1976-1977	2474.2	15.55	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,427.5
1977-1978	2427.5	35.21	10.33	11.52	10.43	819.5	745.0	185.1	1,749.6	42.2	4.4	2,474.2
1978-1979	2474.2	26.49	4.37	6.08	5.33	346.7	393.2	94.6	834.5	42.2	4.4	2,474.2
1979-1980	2474.2	39.31	15.4	17.47	16.73	1221.7	1129.7	297.0	2,648.4	42.2	4.4	2,474.2
1980-1981	2474.2	14.03	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,427.5
1981-1982	2427.5	21.35	1.46	3.59	3.26	115.8	232.2	57.9	405.8	42.2	4.4	2,474.2
1982-1983	2474.2	35.22	6.94	8.17	7.18	550.6	528.3	127.4	1,206.3	42.2	4.4	2,474.2
1983-1984	2474.2	7.30	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,427.5
1984-1985	2427.5	15.47	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,380.9
1985-1986	2380.9	19.46	0	0.51	0.53	0.0	33.0	9.4	42.4	42.2	4.4	2,376.7
1986-1987	2376.7	14.22	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,330.1
1987-1988	2330.1	21.18	0	0	0.1	0.0	0.0	1.8	1.8	42.2	4.4	2,285.3
1988-1989	2285.3	9.47	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,238.7
1989-1990	2238.7	9.47	0	0	0.02	0.0	0.0	0.4	0.4	42.2	4.4	2,192.4
1990-1991	2192.4	20.40	2.76	4.57	4.09	219.0	295.5	72.6	587.1	42.2	4.4	2,474.2
1991-1992	2474.2	11.95	0	0.26	0.42	0.0	16.8	7.5	24.3	42.2	4.4	2,451.8
1992-1993	2451.8	26.38	7.4	9.74	9.34	587.1	629.9	165.8	1,382.7	42.2	4.4	2,474.2
1993-1994	2474.2	17.41	0	0.47	0.61	0.0	30.4	10.8	41.2	42.2	4.4	2,468.8
1994-1995	2468.8	3.42	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,422.2
1995-1996	2422.2	11.34	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,375.5
1996-1997	2375.5	18.19	0.87	3.27	3.17	69.0	211.5	56.3	336.7	42.2	4.4	2,474.2
1997-1998	2474.2	37.36	8.05	9.14	8.21	638.6	591.1	145.7	1,375.4	42.2	4.4	2,474.2
1998-1999	2474.2	16.87	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,427.5
1999-2000	2427.5	10.21	0	0.22	0.39	0.0	14.2	6.9	21.1	42.2	4.4	2,402.1
2000-2001	2402.1	15.32	0	0.96	0.87	0.0	62.1	15.4	77.5	42.2	4.4	2,433.0
2001-2002	2433.0	7.21	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,386.4
2002-2003	2386.4	17.24	0	0	0.07	0.0	0.0	1.2	1.2	42.2	4.4	2,341.0
2003-2004	2341.0	15.26	0	0.64	0.76	0.0	41.4	13.5	54.9	42.2	4.4	2,349.3
2004-2005	2349.3	32.38	6.77	8.95	8.28	537.1	578.8	147.0	1,262.8	42.2	4.4	2,474.2
2005-2006	2474.2	17.73	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,427.5
2006-2007	2474.2	10.47	0	0	0	0.0	0.0	0.0	0.0	42.2	4.4	2,427.5
2007-2008	2427.5	23.93	5.75	8.06	7.7	456.2	521.2	136.7	1,114.1	42.2	4.4	2,474.2
	Mean	**18.0**	**1.77**	**2.56**	**2.40**	**140.1**	**165.3**	**42.6**	**348.1**	**42.2**	**4.4**	**2417.3**

Proposed Project and Current Basin Buildout
Groundwater in Storage
1,940-Acre Freedom Ranch Watershed

Maximum storage	2474.2	acre-feet
One half	1237.1	acre-feet
Minimum calculated	2,153.3	acre-feet

Rock Type	Saturated b	Area	S	Total in storage
Fractured Rock (Flat)	500	1727	0.001	863.5
Fractured Rock (Slopes)	500	213	0.0001	10.7
DG	35	910	0.05	1592.5
Alluvium	10	15	0.05	7.5

										Total Groundwater in Storage		2474.2
	Beginning Storage	Total Rainfall	Recharge Flatter Elevations	Recharge Mid-Slope Elevations	Recharge Steeper Elevations	Recharge Flatter Elevations	Recharge Mid-Slope Elevations	Recharge Steeper Elevations	Total Recharge	Offiste Extraction	Onsite Extraction	Ending Storage
Year	(af)	(inches)	(inches/year)	(inches/year)	(inches/year)	(afy)	(afy)	(afy)	(afy)	(afy)	(afy)	(af)
1967-1968	2474.2	15.17	0	1.18	1.21	0.0	76.3	21.5	97.8	42.2	10.0	2,474.2
1968-1969	2474.2	19.64	2.2	4.87	4.73	174.5	314.9	84.0	573.4	42.2	10.0	2,474.2
1969-1970	2474.2	10.05	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,422.0
1970-1971	2422.0	13.95	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,369.8
1971-1972	2369.8	9.26	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,317.6
1972-1973	2317.6	22.48	0.12	1.85	1.48	9.5	119.6	26.3	155.4	42.2	10.0	2,420.8
1973-1974	2420.8	10.71	0	0.82	0.99	0.0	53.0	17.6	70.6	42.2	10.0	2,439.2
1974-1975	2439.2	17.45	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,387.0
1975-1976	2387.0	21.91	0	2.49	2.6	0.0	161.0	46.2	207.2	42.2	10.0	2,474.2
1976-1977	2474.2	15.55	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,422.0
1977-1978	2422.0	35.21	10.33	11.52	10.43	819.5	745.0	185.1	1,749.6	42.2	10.0	2,474.2
1978-1979	2474.2	26.49	4.37	6.08	5.33	346.7	393.2	94.6	834.5	42.2	10.0	2,474.2
1979-1980	2474.2	39.31	15.4	17.47	16.73	1221.7	1129.7	297.0	2,648.4	42.2	10.0	2,474.2
1980-1981	2474.2	14.03	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,422.0
1981-1982	2422.0	21.35	1.46	3.59	3.26	115.8	232.2	57.9	405.8	42.2	10.0	2,474.2
1982-1983	2474.2	35.22	6.94	8.17	7.18	550.6	528.3	127.4	1,206.3	42.2	10.0	2,474.2
1983-1984	2474.2	7.30	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,422.0
1984-1985	2422.0	15.47	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,369.8
1985-1986	2369.8	19.46	0	0.51	0.53	0.0	33.0	9.4	42.4	42.2	10.0	2,359.9
1986-1987	2359.9	14.22	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,307.7
1987-1988	2307.7	21.18	0	0	0.1	0.0	0.0	1.8	1.8	42.2	10.0	2,257.3
1988-1989	2257.3	9.47	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,205.1
1989-1990	2205.1	9.47	0	0	0.02	0.0	0.0	0.4	0.4	42.2	10.0	2,153.3
1990-1991	2153.3	20.40	2.76	4.57	4.09	219.0	295.5	72.6	587.1	42.2	10.0	2,474.2
1991-1992	2474.2	11.95	0	0.26	0.42	0.0	16.8	7.5	24.3	42.2	10.0	2,446.2
1992-1993	2446.2	26.38	7.4	9.74	9.34	587.1	629.9	165.8	1,382.7	42.2	10.0	2,474.2
1993-1994	2474.2	17.41	0	0.47	0.61	0.0	30.4	10.8	41.2	42.2	10.0	2,463.2
1994-1995	2463.2	3.42	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,411.0
1995-1996	2411.0	11.34	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,358.8
1996-1997	2358.8	18.19	0.87	3.27	3.17	69.0	211.5	56.3	336.7	42.2	10.0	2,474.2
1997-1998	2474.2	37.36	8.05	9.14	8.21	638.6	591.1	145.7	1,375.4	42.2	10.0	2,474.2
1998-1999	2474.2	16.87	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,422.0
1999-2000	2422.0	10.21	0	0.22	0.39	0.0	14.2	6.9	21.1	42.2	10.0	2,390.9
2000-2001	2390.9	15.32	0	0.96	0.87	0.0	62.1	15.4	77.5	42.2	10.0	2,416.2
2001-2002	2416.2	7.21	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,364.0
2002-2003	2364.0	17.24	0	0	0.07	0.0	0.0	1.2	1.2	42.2	10.0	2,313.1
2003-2004	2313.1	15.26	0	0.64	0.76	0.0	41.4	13.5	54.9	42.2	10.0	2,315.7
2004-2005	2315.7	32.38	6.77	8.95	8.28	537.1	578.8	147.0	1,262.8	42.2	10.0	2,474.2
2005-2006	2474.2	17.73	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,422.0
2006-2007	2474.2	10.47	0	0	0	0.0	0.0	0.0	0.0	42.2	10.0	2,422.0
2007-2008	2422.0	23.93	5.75	8.06	7.7	456.2	521.2	136.7	1,114.1	42.2	10.0	2,474.2
	Mean	**18.0**	**1.77**	**2.56**	**2.40**	**140.1**	**165.3**	**42.6**	**348.1**	**42.2**	**10.0**	**2406.3**

Proposed Project and Maximum Theoretical Basin Buildout
Groundwater in Storage
1,940-Acre Freedom Ranch Watershed

Maximum storage	2474.2	acre-feet
One half	1237.1	acre-feet
Minimum calculated	1,474.3	acre-feet

Rock Type	Saturated b	Area	S	Total in storage
Fractured Rock (Flat)	500	1727	0.001	863.5
Fractured Rock (Slopes)	500	213	0.0001	10.7
Residuum	35	910	0.05	1592.5
Alluvium	10	15	0.05	7.5

											Total Groundwater in Storage		2474.2
	Beginning		Recharge	Recharge	Recharge	Recharge	Recharge	Recharge	Total	Offsite	Onsite	Ending
	Storage	Total Rainfall	Flatter Elevations	Mid-Slope Elevations	Steeper Elevations	Flatter Elevations	Mid-Slope Elevations	Steeper Elevations	Recharge	Extraction	Extraction	Storage
Year	(af)	(inches)	(inches/year)	(inches/year)	(inches/year)	(afy)	(afy)	(afy)	(afy)	(afy)	(afy)	(af)
1967-1968	2474.2	15.17	0	1.18	1.21	0.0	76.3	21.5	97.8	139.2	10.0	2,422.7
1968-1969	2422.7	19.64	2.2	4.87	4.73	174.5	314.9	84.0	573.4	139.2	10.0	2,474.2
1969-1970	2474.2	10.05	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,325.0
1970-1971	2325.0	13.95	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,175.8
1971-1972	2175.8	9.26	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,026.6
1972-1973	2026.6	22.48	0.12	1.85	1.48	9.5	119.6	26.3	155.4	139.2	10.0	2,032.8
1973-1974	2032.8	10.71	0	0.82	0.99	0.0	53.0	17.6	70.6	139.2	10.0	1,954.2
1974-1975	1954.2	17.45	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	1,805.0
1975-1976	1805.0	21.91	0	2.49	2.6	0.0	161.0	46.2	207.2	139.2	10.0	1,862.9
1976-1977	1862.9	15.55	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	1,713.7
1977-1978	1713.7	35.21	10.33	11.52	10.43	819.5	745.0	185.1	1,749.6	139.2	10.0	2,474.2
1978-1979	2474.2	26.49	4.37	6.08	5.33	346.7	393.2	94.6	834.5	139.2	10.0	2,474.2
1979-1980	2474.2	39.31	15.4	17.47	16.73	1221.7	1129.7	297.0	2,648.4	139.2	10.0	2,474.2
1980-1981	2474.2	14.03	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,325.0
1981-1982	2325.0	21.35	1.46	3.59	3.26	115.8	232.2	57.9	405.8	139.2	10.0	2,474.2
1982-1983	2474.2	35.22	6.94	8.17	7.18	550.6	528.3	127.4	1,206.3	139.2	10.0	2,474.2
1983-1984	2474.2	7.30	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,325.0
1984-1985	2325.0	15.47	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,175.8
1985-1986	2175.8	19.46	0	0.51	0.53	0.0	33.0	9.4	42.4	139.2	10.0	2,068.9
1986-1987	2068.9	14.22	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	1,919.7
1987-1988	1919.7	21.18	0	0	0.1	0.0	0.0	1.8	1.8	139.2	10.0	1,772.3
1988-1989	1772.3	9.47	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	1,623.1
1989-1990	1623.1	9.47	0	0	0.02	0.0	0.0	0.4	0.4	139.2	10.0	1,474.3
1990-1991	1474.3	20.40	2.76	4.57	4.09	219.0	295.5	72.6	587.1	139.2	10.0	1,912.2
1991-1992	1912.2	11.95	0	0.26	0.42	0.0	16.8	7.5	24.3	139.2	10.0	1,787.2
1992-1993	1787.2	26.38	7.4	9.74	9.34	587.1	629.9	165.8	1,382.7	139.2	10.0	2,474.2
1993-1994	2474.2	17.41	0	0.47	0.61	0.0	30.4	10.8	41.2	139.2	10.0	2,366.2
1994-1995	2366.2	3.42	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,217.0
1995-1996	2217.0	11.34	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,067.8
1996-1997	2067.8	18.19	0.87	3.27	3.17	69.0	211.5	56.3	336.7	139.2	10.0	2,255.3
1997-1998	2255.3	37.36	8.05	9.14	8.21	638.6	591.1	145.7	1,375.4	139.2	10.0	2,474.2
1998-1999	2474.2	16.87	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,325.0
1999-2000	2325.0	10.21	0	0.22	0.39	0.0	14.2	6.9	21.1	139.2	10.0	2,196.9
2000-2001	2196.9	15.32	0	0.96	0.87	0.0	62.1	15.4	77.5	139.2	10.0	2,125.2
2001-2002	2125.2	7.21	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	1,976.0
2002-2003	1976.0	17.24	0	0	0.07	0.0	0.0	1.2	1.2	139.2	10.0	1,828.1
2003-2004	1828.1	15.26	0	0.64	0.76	0.0	41.4	13.5	54.9	139.2	10.0	1,733.7
2004-2005	1733.7	32.38	6.77	8.95	8.28	537.1	578.8	147.0	1,262.8	139.2	10.0	2,474.2
2005-2006	2474.2	17.73	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,325.0
2006-2007	2474.2	10.47	0	0	0	0.0	0.0	0.0	0.0	139.2	10.0	2,325.0
2007-2008	2325.0	23.93	5.75	8.06	7.7	456.2	521.2	136.7	1,114.1	139.2	10.0	2,474.2
	Mean	**18.0**	**1.77**	**2.56**	**2.40**	**140.1**	**165.3**	**42.6**	**348.1**	**139.2**	**10.0**	**2150.8**

E. Groundwater Monitoring and Management Plan

Appendix E
Groundwater Monitoring and Management Plan

The Freedom Ranch Facility is solely reliant on groundwater for domestic water requirements in an area with finite groundwater resources. Such use is contingent on the on-going implementation of a Groundwater Monitoring and Management Plan (GMMP) that consists of the following requirements:

Groundwater Production and Water Level Monitoring

- Instantaneous and cumulative flow meters shall be installed to monitor groundwater usage on all current production wells (currently production Well-12) and future production wells.
- Instantaneous and cumulative groundwater production from the flow meters shall be monitored and recorded monthly in all production wells.
- Groundwater levels shall be measured monthly at Well-12 and Well-13 for the first two years of groundwater production of site operations after build out is completed. At that time, pending an evaluation of the water level and pumping data base, water level measurement frequency may be reduced to every three months upon Planning & Development Services (PDS) approval.

Whenever possible, groundwater production wells shall be de-activated for at least eight hours before measuring groundwater levels. Additionally, a repeat water level measurement shall be taken at a production well no sooner than five minutes after the initial measurement to assess how dynamic the water level is in the pumping well.

The facility shall track groundwater production over time and assess the rate of production compared to the annual production limit of 10 acre-feet per year to better assure deviations from anticipated water use are identified early and excess water demands reduced. The tracking shall be conducted bearing in mind that groundwater demand is expected to be highest during the summer months.

Groundwater Monitoring & Management Criteria

The criteria for groundwater production monitoring shall be the annual groundwater production, from January 1 through December 31, shall not exceed a total production of 10 acre-feet per year (3,258,510 gallons). This limit does not include water used for fire protection during an emergency situation. Carry over of water not used from other years shall not be permitted. A summary of the production monitoring schedule and threshholds is provided on Table 1.

If total groundwater production exceeds **8.5 acre-feet** by November 1st, the following steps will be taken:

- Within seven days notify the Director of PDS (the Director) via phone call and e-mail
- Rigorous conservation measures will be implemented including reduction of landscape irrigation
- Water production data will be collected twice a week
- A monthly report will be filed with the Director by the 15th of the following month to ensure compliance with these requirements

If total groundwater production exceeds **9.2 acre-feet** by December 1st, the following steps will be taken:

- Within seven days notify the Director of PDS via phone call and e-mail
- Rigorous conservation measures will be implemented including elimination of landscape irrigation
- Water production data shall be collected twice a week
- Arrangements shall be prepared to provide domestic water to the facility via tanker truck from outside the basin on a temporary basis if groundwater production exceeds 9.5 acre-feet. The source of potable water shall either be from an imported water source or from a PDS-approved groundwater source. If implemented, this mitigation would not be expected to be either a long-term or an annual solution to a water budget deficit.
- A monthly report will be filed with the Director by the 15th of the following month to ensure compliance with these requirements.

If total groundwater production reaches **10 acre-feet** prior to the end of the calendar year, the following steps will be taken:

- Terminate groundwater production at all wells
- Provide domestic water to the facility via tanker truck from outside the basin on a temporary basis until the beginning of the calendar year
- Evaluate cause of excess water demand and develop plan to reduce water demand. Submit plan to the Director by January 31st of the new calendar year.

Reporting

Data from groundwater production and water level monitoring shall be submitted to PDS annually. The monitoring report shall cover the period of January 1st to December 31st, and shall be due on January 31st. The report shall include a chart of groundwater production over time and water level hydrographs.

Future Production Wells

Future replacement production wells may be installed near production Well-12 with written approval from PDS. Replacement wells should not be placed closer to offsite production wells to ensure impacts to offsite wells remain less than significant. Additionally, groundwater production and water levels shall be recorded from any future production well.

Table 1. Summary of Monitoring Schedule and Thresholds

Threshold (af)	Threshold (gallons)	Measured Before Date	Action
8.5	2,769,734	01-November	Reduce Landscape Irrigation
9.2	2,997,829	01-December	Eliminate Landscape Irrigation
10.0	3,258,510	31-December	Terminate Groundwater Use