

FINAL

**Groundwater Monitoring and Mitigation Plan  
Rugged Solar Farm Project  
Major Use Permit 3300-12-007  
Boulevard, San Diego County, California**

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# Groundwater Monitoring and Mitigation Plan

## Rugged Solar Farm Project

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### 1.0 INTRODUCTION

The proposed Rugged Solar Farm Project (Project) consists of a 765-acre solar energy system located north of Interstate 8 (I-8) to the east of Ribbonwood Road and primarily west of McCain Valley Road in southeast San Diego County. Residents and government agencies in this area rely on groundwater as their sole source of water supply. The Project will pump groundwater from three on-site production wells (Wells 6a, 6b and 8) to help meet its construction and operational water demand. This Groundwater Monitoring and Mitigation Plan (GMMP) has been prepared on behalf of Rugged LLC by Dudek in order to provide protection to nearby groundwater-dependent habitat and ensure adequate groundwater supply for other groundwater users in the area.

As described in the Groundwater Resources Investigation Report for the proposed Rugged Solar Farm Project (Dudek, 2013), the Project will require an estimated 59 acre-feet of water during the 1 year construction period and 8.7 acre-feet per year (afy) thereafter to meet operational demand. An estimated 44 acre-feet of construction water will be pumped from the three on-site groundwater production wells: 6a, 6b and 8 (Figure 1). Since the on-site production wells cannot meet short-term construction water demands, additional capacity up to 16 acre-feet will be supplied by off-site groundwater or municipal sources. Peak construction demand will occur over approximately 60 working days while site clearing, grubbing and grading take place. At the conclusion of these activities, a soil tackifier will be applied to stabilize soils. Following this application, construction water demand will be limited to dust control for the remainder of the approximately 1 year Project construction period. Operational water demand will be driven primarily by washing of the concentrator photovoltaic (CPV) panels. Other sources of operational water demand include sanitary and drinking water for the operation and maintenance (O&M) building and annual application of soil binding stabilization agent. It is anticipated that the estimated 8.7 acre-feet of average annual operational water demand will be entirely met using groundwater from the three on-site production wells. The operational demand is relatively low, with an annual average pumping rate of 16.2 gpm if the entire demand is supplied by a single well operated an average of 8 hours per day. The demand is equivalent to the use associated with 18 single-family residences located on the 765 acre property and less than would be expected for residential buildout.

Results of the Groundwater Resources Investigation indicate that the short-term production of construction water from Wells 6a, 6b and 8 would result in a less than significant impact to groundwater storage and groundwater levels at off-site wells. As the historical low groundwater level near the groundwater-dependent habitat is unknown, significant impacts to this habitat may result due to groundwater extraction from Wells 6a and 6b over the short-term. Long-term

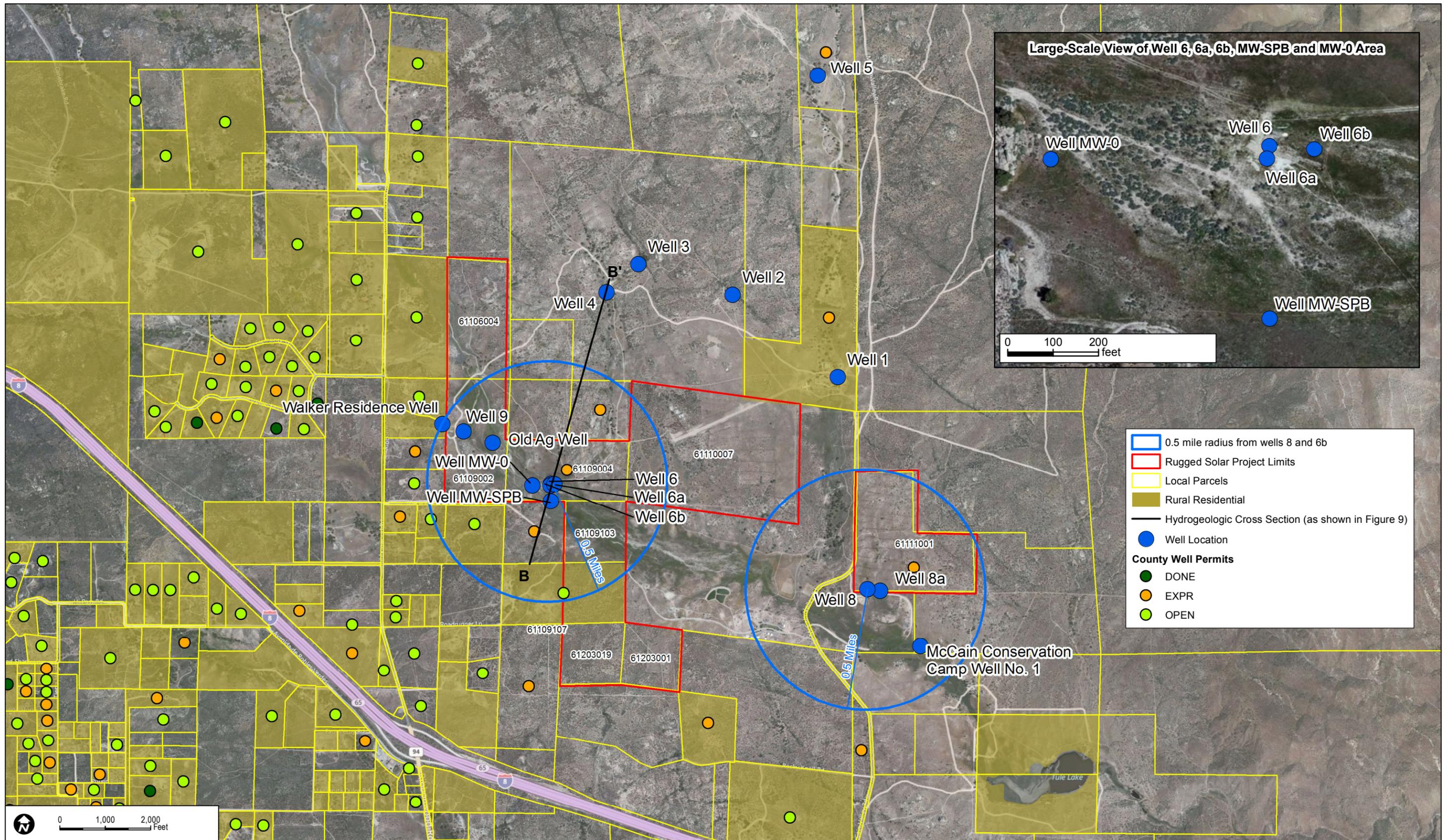
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operational water demands are relatively low, well within the sustainable yield of the aquifer system, and have minimal impact.

Because significant impacts to groundwater dependent habitat may result due to groundwater extraction from Wells 6a and 6b over the short-term and actual conditions during groundwater extraction for the Project may vary from conditions assumed in the Groundwater Resources Investigation (Dudek 2103), this GMMP has been prepared for the Rugged Solar Farm Project. This GMMP establishes protective groundwater drawdown thresholds for off-site well interference and groundwater-dependent habitat and provides the technical basis for the application of water level (drawdown) thresholds.

This GMMP also describes the monitoring, mitigation and reporting procedures by which the County of San Diego Planning and Development Services (PDS) can ensure that the conditions and criteria for the Project's groundwater extraction activities are continually being upheld. Up to a 5 year monitoring period is proposed to assess the impact of the short-term construction water demand, as operational demands are minimal.



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## 2.0 ESTABLISHMENT OF GROUNDWATER THRESHOLDS

According to the County of San Diego Guidelines for Determining Significance and Report Format Content Requirements (County of San Diego, 2007), this Project-related groundwater extraction would incur a significant well interference impact if it results in a decrease in saturated thickness of 5% (20 feet or greater off-site groundwater drawdown in a fractured rock aquifer assuming 400 feet saturated thickness and a 5 foot or greater off-site groundwater drawdown in an alluvial aquifer assuming 100 feet of saturated thickness). Additionally, the County’s Guidelines for Determining Significance for Biological Resources (County of San Diego, 2010) defines a project-related drawdown of 3 feet below historical low groundwater levels as causing a significant impact to riparian habitat or a groundwater sensitive natural community. The thresholds established below incorporate these guidelines and represent a conservative basis for monitoring and mitigating potential groundwater impacts related to the Project.

### 2.1 Potential Off-Site Well Interference

Based on the findings of the Groundwater Resources Investigation Report (Dudek, 2013), two well interference thresholds have been established: one for Wells 6a and 6b and one for Well 8.

#### 2.1.1 Wells 6a and 6b

Three off-site residential wells have been identified within 2,700 feet of pumping Wells 6a and 6b (Dudek, 2013; GLA 2010; GLA 2012). However, the exact location of only one of these wells, the Walker Residence Well, is known. This well is located approximately 2,700 feet northwest of Wells 6a and 6b. The closest property line is 439 feet south of the pumping wells, which is shared with a non-residential, undeveloped parcel. The closest property with a residential groundwater well (APN 611-091-07) is located 1,742 feet from the pumping wells (Table 1).

**Table 1**  
**Well Users within 0.5 Mile Radius of Wells 6a/6b**

Well Number	APN	Use	Distance from Wells 6a/6b
Old Ag Well	611-090-02 (RAR Well)	Agriculture	1,571
Well 9	611-090-02 (RAR Well)	Agriculture	2,262
Walker Weill	611-090-19	Domestic	2,700
<i>Off-site Confidential Wells<sup>b</sup></i>			
17532		Agriculture	439 <sup>a</sup>
11104		Domestic	1,742 <sup>a</sup>

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**Table 1**  
**Well Users within 0.5 Mile Radius of Wells 6a/6b**

Well Number	APN	Use	Distance from Wells 6a/6b
9119		Agriculture	2,326 <sup>a</sup>
10107		Agriculture	2,421 <sup>a</sup>
11106		Domestic	2,429 <sup>a</sup>

a Reported distance is to property line as the exact well location is unknown.

b Assessor parcel numbers (APN) are redacted for confidential well logs.

Due to lack of access to the existing off-site wells and their distance from the pumping Wells 6a and 6b, a new monitoring well will be installed approximately 350 feet south of Well 6a (Figure 1), referred to hereafter as the Southern Property Boundary Monitoring Well (MW-SPB), to serve as the Well 6a and 6b monitoring point for compliance with the groundwater drawdown guidelines established by the County. MW-SPB will be installed to a depth of approximately 480 feet below ground surface (bgs). Once installed, MW-SPB will be fitted with a pressure transducer to record water levels. Multiple manual water level measurements will be recorded with a sounder to confirm the accuracy of the transducer.

Groundwater will also be extracted from wells 6a and 6b during construction of the Tule Wind and Rough Acres Ranch projects. As the baseline water levels need to be established prior to the onset of any water extraction, well MW-SPB will be installed at least 1 month prior to the onset of groundwater extraction from any of the projects slated to use wells 6a and 6b. Baseline water level conditions in MW-SPB will be established through water level measurements recorded by the pressure transducer for at least 1 month prior to the onset of groundwater extraction.

During pumping at Wells 6a and 6b, a maximum drawdown of 15 feet (rounded) below the water level baseline at MW-SPB located 350 feet from Well 6a will be allowed. This threshold is protective of a maximum drawdown of 10 feet at the closest property with a residential groundwater well located approximately 1,742 feet from the pumping wells. This protective threshold will prevent drawdown at the nearest off-site wells, which are farther from MW-SPB, from approaching the 10 feet threshold set forth by the County. The 10 feet limit is a hybrid of the 20 feet or greater off-site groundwater drawdown in a fractured rock aquifer and the 5 feet or greater off-site groundwater drawdown in an alluvial aquifer developed in consultation with the County Groundwater Geologist as both alluvial and fractured rock aquifers are present in the vicinity of Wells 6a and 6b.

Dudek will make efforts to contact the property owner of residential parcel APN 611-091-07 in an attempt to access the groundwater well on this property. If successfully accessed, a pressure transducer will be deployed in this well approximately 1 month prior to groundwater extraction

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to establish a baseline water level. Transducer accuracy will be confirmed with manual water level measurements recorded with a sounder. If accessed, this residential well will serve as a monitoring point for off-site well interference due to pumping at Wells 6a and 6b. A conservative threshold of 10 feet of drawdown below the water level baseline will be established at this well.

### 2.1.2 Well 8

The nearest off-site well to the pumping well, Well 8, is the McCain Conservation Camp Well, located approximately 1,800 feet southeast of Well 8 (Figure 1), which will likely be accessible for monitoring during pumping at Well 8 (Table 2).

**Table 2**  
**Well 8 Well Users within 0.5 Mile Radius**

Well Number	APN	Use	Distance from Wells 6a/6b
McCain Conservation Camp Well	611-100-06	Government/Potable	1,800

The McCain Conservation Camp well will serve as the Well 8 monitoring point for compliance with groundwater drawdown guidelines established by the County. It will be fitted with a pressure transducer in the summer or fall of 2013, prior to the onset of potential pumping from the Tule wind or Rough Acres Ranch projects. The pressure transducer will record the water level in the well at 15 minute intervals for approximately 1 year prior to the onset of Project related groundwater extraction. Transducer accuracy will be confirmed through manual water level measurements recorded with a sounder. The measurements collected from the McCain Conservation Camp Well over this year will be used to establish a water level baseline and capture water level patterns generated by pumping of this well. An understanding of these patterns will allow for this well's continued use as a monitoring well despite the possibility that it may be pumped over the duration of the Project. During pumping at Well 8, a maximum drawdown of 10 feet below the pumping baseline in the McCain Conservation Camp Well will be allowed. This threshold takes into account the County guidelines for limiting drawdown in both fractured rock and alluvial aquifers.

## 2.2 Groundwater Dependent Habitat

The Groundwater Resources Investigation Report identifies two groundwater-dependent vegetation communities mapped near Wells 6a and 6b (Figure 2) that can likely access water from the alluvial aquifer; coast live oak (*Quercus agrifolia*) and mixed oak woodland and tamarisk scrub (*Tamarix ramoissima*). The nearest coast live oak woodland and tamarisk scrub

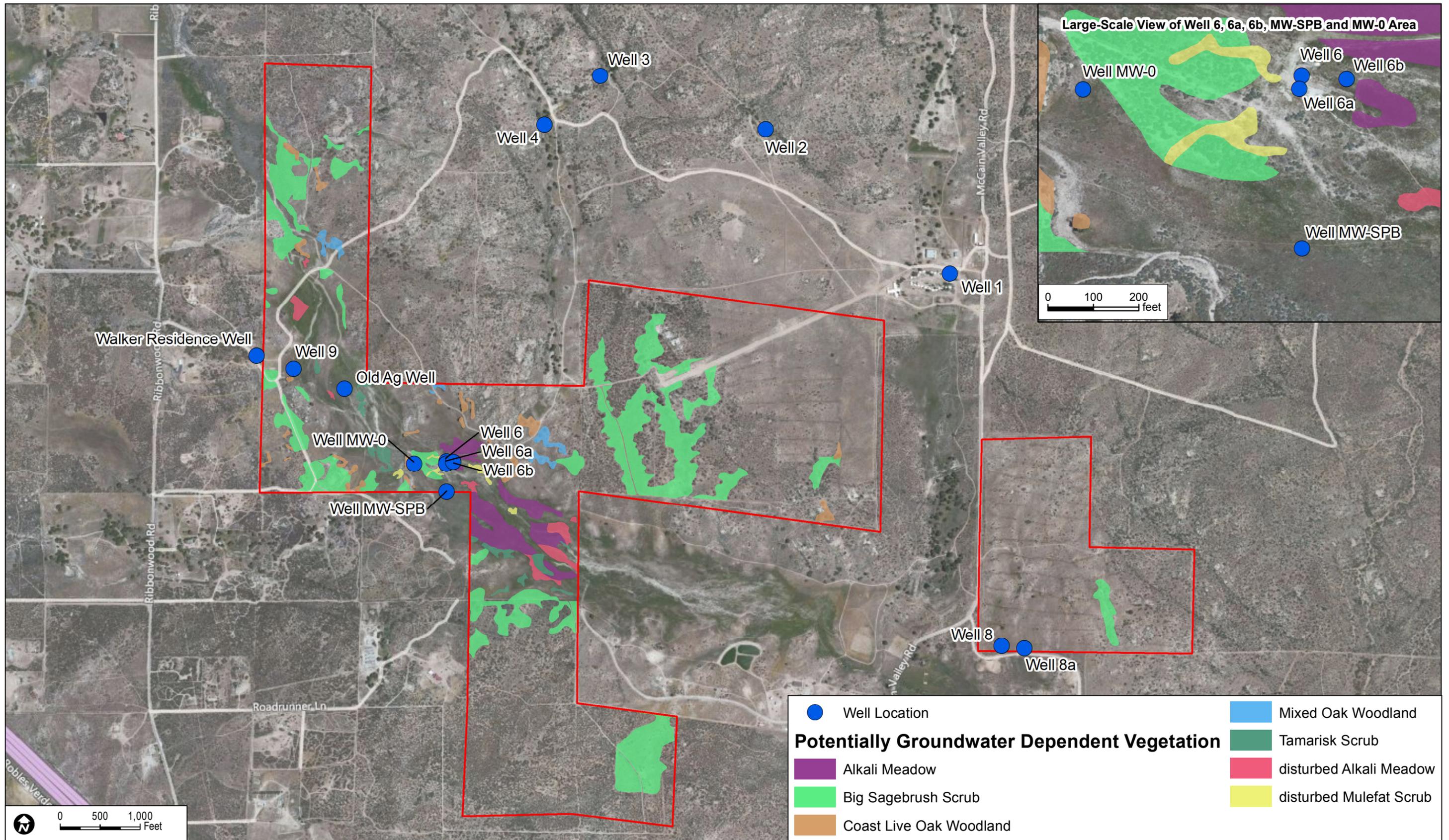
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are located 447 feet and 700 feet, respectively from Wells 6a and 6b. Of these two communities, the coast live oak woodland is of greater concern due to its closer proximity to the pumping wells. The root system of individual coast live oaks has been found to extend to depths of 36 feet below ground surface (Candell et al. 1996). A new monitoring well, referred to hereafter as Oak Monitoring Well (MW-O), will be installed with a hollow-stem auger as close as possible to the coast live oak and mixed oak woodland, approximately 400 feet west of Wells 6a and 6b. The completion depth of MW-O will correspond to the depth of the alluvium, which is approximately 60 to 80 feet bgs in the vicinity of Wells 6a and 6b. As the baseline water levels need to be established prior to the onset of any water extraction, well MW-O will be installed at least 1 month prior to the onset of groundwater extraction from any of the projects slated to use wells 6a and 6b.

The historical low groundwater level in the vicinity of the oak woodland is not known over the period corresponding to the lifespan of mature oaks. This lack of historical water level data precludes determination of a water level threshold 3 feet below the historical low. Therefore, routine biological monitoring of the oak woodland for the duration of the 1 year Project construction period will serve as a means to continually assess oak health. Biological monitoring procedures are described below in section 3.2. If an International Society of Arboriculture (ISA) Certified Arborist or Registered Profession Forester observes that no impact to the oak woodland has occurred over the construction period, biological monitoring of the oak woodland will cease. In addition to biological monitoring, a water level threshold of 10 feet of drawdown below baseline at MW-O will be established to protect the oaks' ability to continually access groundwater from the alluvial aquifer.

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



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### **3.0 MONITORING PROCEDURES AND MITIGATION CRITERIA**

The groundwater and biological monitoring procedures and mitigation criteria outlined below will be followed during the 1 year construction period and throughout the operational duration of the Project. The groundwater monitoring program defined herein will be carried out under the direction of a Certified Hydrogeologist registered in the State of California. The groundwater-dependent habitat monitoring will be carried out under the direction of an ISA Certified Arborist or Registered Professional Forester.

#### **3.1 Groundwater Production and Water Level Monitoring**

Pressure transducers will be maintained in four existing on-site monitoring wells (Well 6, Well 8a, Well 9 and Old Ag Well, Figure 1), six off-site monitoring wells (Well 1, Well 2, Well 3, Well 4, Well 5 and the McCain Conservation Well, Figure 1) and two on-site production wells (Well 6b and Well 8). Transducers will also be installed in the proposed well MW-SPB near pumping Wells 6a and 6b and the proposed well MW-O near the on-site oak woodland. The pressure transducers will be programmed to record the water level every 15 minutes. In addition, ambient barometric pressure and temperature will be recorded at 15 minute intervals with a barometric logger.

Transducer data will be downloaded on a monthly basis during Project construction and quarterly basis during Project operation. During the approximately 60 day period of peak construction water demand, transducer data will be downloaded weekly at the three pumping wells (Well 6a, Well 6b and Well 8) as well as at the following four monitoring wells: Well 8a, the McCain Conservation Camp Well, MW-SPB and MW-O.

Instantaneous flow meters will be installed on the three production wells (Well 6a, Well 6b and Well 8) to monitor cumulative groundwater usage. Flow rate and volume measurements will be recorded daily during Project construction peak water demand and weekly thereafter. Flow rate and volume measurements will be recorded monthly during project operation.

#### **3.2 Groundwater Dependent Habitat Monitoring**

The following monitoring program will establish the current status and health of the existing oak woodland and document oak conditions over a maximum of 5 years post-construction timeframe. The goal is to determine if the Project's use of groundwater is impacting area oak trees/woodlands.

##### **3.2.1 Baseline Data Collection**

Baseline data will be collected over the course of 1 year prior to Project-related groundwater extraction. Potentially affected native trees within the study area will be evaluated for overall

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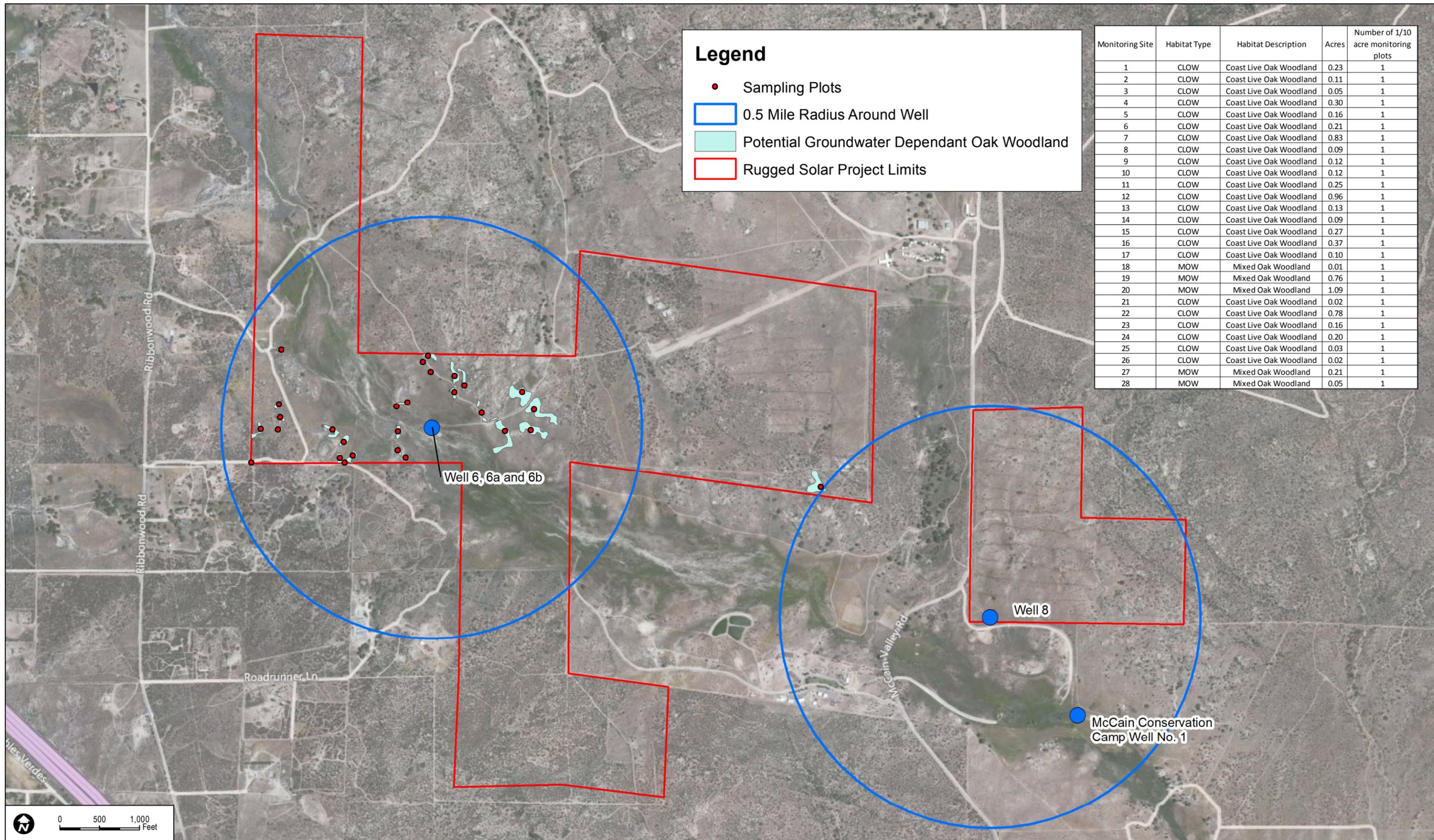
physical condition and attributes. The trees shall be inventoried by an ISA Certified Arborist or Registered Professional Forester with specific experience evaluating native oak species, in particular coast live oaks. The baseline monitoring evaluations will include the following:

- Establishment of 28 pseudo-randomized 0.2 acre plots around oak groupings and scattered individual trees (Figure 3). Sample plots would include the range of existing habitat conditions, including elevation, slope and aspect, proximity to roads and other land uses. If an oak woodland monitoring site is less than 0.1 acre, the entire site will be evaluated.
- Tagging of trees and recording species, tag number, trunk diameter at breast height (dbh) (in.), height (ft.) and dominance (i.e., whether the tree is under the canopy of another tree or forms the uppermost canopy). Slope, aspect, and elevation of each tree location, existing understory species (including proportion of natives to exotics), presence of debris and litter, and soil type, depth, and parent material will be noted for each tree or plot.
- Placement of tensiometers (or similar) to measure soil moisture levels
  - Soil moisture levels will be recorded quarterly at depths up to 48-inches
- Assessment of tree status, including documentation of:
  - Dbh, measured at 4.5 feet above ground (according to standard practices)
  - Number of stems
  - Overall tree height (based on ocular estimates)
  - Tree crown spread (measurement in each cardinal direction, based on ocular estimate)
  - Overall tree health condition (Good, Fair, Poor, Dead)
  - Overall tree structural condition (Good, Fair, Poor, Dead)
  - Pest presence (Type, Extent – minimal, moderate, high)
  - Disease presence (Type, Extent – minimal, moderate, high)
  - Other specific comments
- Assessment of acorn production, seedling establishment and sapling tree densities and conditions
- The data collection procedure will include full data collection at each plot so that consistency is maintained among sampling plots.

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- Creation of oak tree database using GIS or similar application



**Legend**

- Sampling Plots
- 0.5 Mile Radius Around Well
- Potential Groundwater Dependant Oak Woodland
- Rugged Solar Project Limits

Monitoring Site	Habitat Type	Habitat Description	Acres	Number of 1/10 acre monitoring plots
1	CLOW	Coast Live Oak Woodland	0.23	1
2	CLOW	Coast Live Oak Woodland	0.11	1
3	CLOW	Coast Live Oak Woodland	0.05	1
4	CLOW	Coast Live Oak Woodland	0.30	1
5	CLOW	Coast Live Oak Woodland	0.16	1
6	CLOW	Coast Live Oak Woodland	0.21	1
7	CLOW	Coast Live Oak Woodland	0.83	1
8	CLOW	Coast Live Oak Woodland	0.09	1
9	CLOW	Coast Live Oak Woodland	0.12	1
10	CLOW	Coast Live Oak Woodland	0.12	1
11	CLOW	Coast Live Oak Woodland	0.25	1
12	CLOW	Coast Live Oak Woodland	0.96	1
13	CLOW	Coast Live Oak Woodland	0.13	1
14	CLOW	Coast Live Oak Woodland	0.09	1
15	CLOW	Coast Live Oak Woodland	0.27	1
16	CLOW	Coast Live Oak Woodland	0.37	1
17	CLOW	Coast Live Oak Woodland	0.10	1
18	MOW	Mixed Oak Woodland	0.01	1
19	MOW	Mixed Oak Woodland	0.76	1
20	MOW	Mixed Oak Woodland	1.09	1
21	CLOW	Coast Live Oak Woodland	0.02	1
22	CLOW	Coast Live Oak Woodland	0.78	1
23	CLOW	Coast Live Oak Woodland	0.16	1
24	CLOW	Coast Live Oak Woodland	0.20	1
25	CLOW	Coast Live Oak Woodland	0.03	1
26	CLOW	Coast Live Oak Woodland	0.02	1
27	MOW	Mixed Oak Woodland	0.21	1
28	MOW	Mixed Oak Woodland	0.05	1



**FIGURE 3**  
**Oak Woodland Monitoring Locations**

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### **3.2.2 Ongoing Monitoring**

Ongoing monitoring will be carried out quarterly during the 1 year Project construction period. If the ISA Certified Arborist or Registered Professional Forester observes an impact to the oak woodland after this period, monitoring will continue in years 2 through 5 following initiation of Project-related groundwater extraction. Monitoring will include the following components:

- Monitoring inspections will include re-evaluation of the baseline data as well as collection of soil moisture data from pre-placed tensiometers.
- Monitoring will include re-evaluating the trees to determine if changes are occurring that may indicate ground water drawdown is having a deleterious effect on oak woodlands or individual trees. The following information will be recorded during each monitoring visit and the data will be compared to previous monitoring results:
  - Dbh, measured at 4.5 feet above ground (according to standard practices)
  - Number of stems
  - Overall tree height (based on ocular estimates)
  - Tree crown spread (measurement in each cardinal direction, based on ocular estimate)
  - Overall tree health condition (Good, Fair, Poor, Dead)
  - Overall tree structural condition (Good, Fair, Poor, Dead)
  - Pest presence (Type, Extent – minimal, moderate, high)
  - Disease presence (Type, Extent – minimal, moderate, high)
  - Other specific comments

In particular, monitoring evaluations will focus on examining crowns for discoloration, loss of vigor, foliage curling, and/or pest presence; and trunks and root crowns for beetle/borer symptoms, bleeding cankers, or seeping areas (indicative of fungal infections). These and similar signs may indicate that a tree or a grouping of trees is experiencing stress, which can be corroborated by tensiometer readings. Trees under stress are more susceptible to disease and insect attacks.

### **3.3 Groundwater Mitigation Criteria**

The following mitigation criteria will be established to protect groundwater resources and groundwater-dependent habitat in the Project area:

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- If the groundwater level at well MW-SPB reaches or drops below 15 feet of the baseline level, groundwater pumping at Wells 6a and 6b will cease until the water level at MW-SPB has increased above the threshold and remained there for at least 30 continuous days. This threshold will prevent water levels at the closest property with a residential groundwater well from dropping below 10 feet of the pre-pumping baseline, as described in section 2.1.1. Additionally, written permission from the County PDS must be obtained before production may be resumed.
- If the groundwater level at the McCain Conservation Camp Well reaches or drops below 10 feet of the baseline pumping water level trend, groundwater pumping at Well 8 will cease until the water level at McCain Conservation Camp Well has increased above the threshold and remained there for at least 30 continuous days. Additionally, written permission from the County PDS must be obtained before production may be resumed.
- If the groundwater level at well MW-O drops more than 10 feet below the pre-pumping level and there is evidence of deteriorating oak tree health by the Arborist or Forester, there may be a temporary or permanent cessation of pumping at Well 6a/6b. If the evidence of deterioration persists after the 5 year period, mitigation will consist of off-site wetland/oak woodland credits at a 3:1 ratio.
- If an impact to the oak woodland habitat is observed by the monitoring ISA Certified Arborist or Registered Professional Forester over the duration of the Project construction period, routine monitoring of the oak woodland will continue for a maximum up to 5 years following initiation of Project-related groundwater extraction. The monitoring Certified Arborist or Registered Professional Forester will base mitigation recommendations on the type and extent of tree issues observed. If groundwater drawdown is determined to be the cause of tree stress, resulting in the presence of secondary pests (insects and/or disease), halting groundwater extraction may be recommended.
- If less than 3 feet of drawdown is observed at monitoring well MW-O at the end of Project construction and no deleterious health effects are observed in the oak woodland habitat, monitoring can cease at the end of the first year of project operation as long as the wells operate only as intended under the Project's conditions of approval.

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### **4.0 REPORTING REQUIREMENTS**

A groundwater monitoring report will be completed by a Certified Hydrogeologist registered in the State of California and submitted to the County PDS each month, no later than 28 days following the end of the monitoring month. The report will include the following information:

- Water level hydrographs and tabulated water level data for each monitoring well.
- Tabulated groundwater production volumes from each production well.
- Documentation of groundwater drawdown at well MW-SPB, the McCain Conservation Well and well MW-O.
- Documentation of any threshold-included curtailment of groundwater production.

If the water levels at well MW-SPB, the McCain Conservation Camp Well or well MW-O are exceeded, the County PDS will be notified via letter and electronic mail within five working days of the exceedance.

In addition to the monthly groundwater monitoring reports, annual reports will also be submitted to the county PDS summarizing groundwater-dependent habitat monitoring efforts and any mitigation recommendations implemented in the field during the monitoring year. The monitoring year will coincide with the calendar year. The annual reports will document tree health and mortality, tensiometer readings, water level readings, well production and success of mitigation efforts (if any were necessary). Annual reports will be completed prior to the end of January in the next calendar year.

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### **6.0 LIST OF PREPARERS**

This GMMP was prepared by Dudek Hydrogeologists, Trey Driscoll, PG, CHG and Lydia Roach, PhD. Dudek Arborist; Michael S. Huff prepared the monitoring program for the groundwater dependent habitat. Dudek Hydrogeologist Stephen K. Dickey, PG, CHG, CEG, provided review assistance and coordination with the County as the County-approved hydrogeologist. Peter Quinlan, RG and principal-in-charge, and Jill Weinberger, PhD, PG, provided peer review of this GMMP.

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