COMPREHENSIVE HYDROGEOLOGIC REPORT

PARAISO HOT SPRINGS RESORT

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1. INTRODUCTION

1.1. PURPOSE

This Comprehensive Hydrogeologic Report documents the groundwater conditions, groundwater supply availability, and potential hydrologic impacts of the proposed Paraiso Springs Resort Development Project (Project) in Paraiso Springs Valley. The valley is at the foot of the Santa Lucia Range and opens into the much larger Salinas Valley near the City of Soledad in Monterey County, California (**Figure 1**). This report meets the requirements listed in Monterey County Municipal Code Section 19.03.015, including evaluations of the hydrogeologic setting, topography, geology, meteorology, aquifer characteristics, groundwater levels and flow, groundwater storage, groundwater quality, and groundwater balance. The water balance incorporates data for rainfall, runoff, evapotranspiration, and existing and Project water demand. Impacts of the Project on local and regional water resources are evaluated, and mitigation measures are identified.

1.2. PROJECT SUMMARY

The property owners propose to renovate the existing and antiquated resort in a modernization project. As described in the draft environmental impact report (DEIR), The Project includes construction of the following facilities (EMC Planning, Inc., 2013):

- Hotel consisting of 103 one- and two-story clustered visitor-serving hotel units, three restaurants, nine meeting and conference rooms, activity terrace with croquet and bocce ball courts and associated support facilities;
- 34 two-bedroom and 26-three bedroom timeshare units;
- Hamlet consisting of a day spa, a general retail store, artist studios, wine tasting, garden center and real estate office;
- 17 timeshare villas;
- Spa and fitness center consisting of courtyard gardens, teahouse, spa water gardens, labyrinth, activity center, lap pool, vitality pavilions, indoor golf school, putting greens, basketball pavilion, racquetball pavilion, tennis courts and ornamental therapy stream and pool;
- Wine pavilion and associated vineyard;
- Paraiso Institute for training and other special events;
- Visitor center;
- Amphitheater stage and pavilion, amphitheater lawn;
- Garden center;
- Laundry and maintenance facilities;
- Hiking trails, trailside outlooks, and natural solarium area;
- Ornamental streams;
- Landscaping of the grounds;
- Roadways, paths, pedestrian and vehicular bridges;

- Groundwater treatment system;
- 500,000 gallon above-ground water storage tank;
- Underground recycled water storage reservoir (1.5-4.1 million gallons);
- Wastewater treatment plant.

Figure 2 shows the layout of the proposed facilities superimposed on a topographic map of Paraiso Springs Valley and adjacent hillsides.

The proposed project would have an average annual potable water demand of 34,400 gallons per day (38.6 acre-feet per year [AFY]) at buildout, assuming average occupancy[1]. The proposed project would be served by two existing wells located near the western (upstream) end of the valley (CH2MHill 2010a). Well No. 1 would serve as the main water supply and Well No. 2 would serve as the back-up water supply. An additional 1.9 AFY of water would be pumped to operate the fluoride removal facility. The potable water supply system would also be used for irrigation, but only to the extent that the annual supply of recycled water is insufficient to meet annual irrigation demand.

All wastewater would be treated and recycled for irrigation use. The potable water demand does not include water for the proposed pools and spas as water for these facilities will be supplied from the existing hot springs rather than the potable water supply.

The proposed project would generate a maximum of 38,800 gallons per day of wastewater during periods of high occupancy, assuming 90 percent of the water delivered through the potable supply system becomes wastewater. Wastewater would flow to a new wastewater treatment and distribution system at the eastern end of the project site, near the entrance of the project site, downhill from the main resort area. The existing septic tank/leach field system that serves the two current residents would be removed.

The wastewater treatment facility would consist of a membrane bioreactor combined with ultraviolet light disinfection. Influent raw wastewater would pass through a fine screen at the head of the treatment plant to remove coarse organic and inorganic material. A macerating and washing process would return most of the organic matter to the waste stream. The residual waste would be compacted and disposed of at an off-site landfill. The membrane bioreactor process would remove most of the biological oxygen demand and reduce nitrate-nitrogen levels to less than 6 mg/L, which is themaximum concentration allowed in Monterey County for projects that recharge groundwater with recycled water. This is more conservative than necessary, because all wastewater produced by the project would be recycled for irrigation within the project site and applied at agronomically appropriate rates so that all of the nitrate is taken up by plants.

Four existing culverts located along the drainage channel will be removed as part of the proposed project. In these areas, the drainage channel will be restored to a more natural shape and capacity. However, within a 300-foot section of the channel (the fourth proposed

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[1] Two occupancy levels are used throughout this report for different purposes: average and high. They are defined in Section 7 “Water Demand and Supply”

culvert removal), a new in-stream pond will be created that will be filled using overflow from the spring (WRA, 2016).

1.3. DATA SOURCES

Data sources for this report include published geologic and hydrogeologic reports for the project area and surrounding region, including:

- Paraiso Springs Resort Draft Environmental Impact Report – EMC Planning, Inc., 2013.
- Geologic Map of Paraiso Springs Quadrangle, California – USGS (Durham), 1970.
- Geologic Map of Soledad Quadrangle, California – USGS (Dibblee), 1974.
- Geologic and Soil Engineering Feasibility Report for Paraiso Hot Springs Resort – LandSet Engineers, 2004.
- Paraiso Springs Resort 10-day Pumping Test Results – CH2M HILL, 2008a.
- Paraiso Springs Resort—Response to Hydrology and Hydraulic Analysis and Erosion Control Measures Review Comments – CH2M HILL, 2008b.
- Paraiso Springs Resort—Estimated Potable Water Demand and Potable Water Source – CH2M HILL, 2010a.
- Paraiso Springs Resort—Estimated Wastewater Production and Proposed Treatment, Irrigation and Storage – CH2M HILL, 2010b.
- Section 404 Wetland Delineation, Paraiso Springs Resort – WRA, 2016.

In addition, data for analysis were retrieved from on-line sources including Google Earth, the California Irrigation Management and Information System (CIMIS), the Western Regional Climate Center and National Resources Conservation Service. Information was also obtained from public and agency comments on the DEIR, which were compiled and provided by Monterey County Planning Department, and from a peer review of a previous draft of this report (Balance Hydrologics, Inc., 2016).

2. SITE DESCRIPTION

The proposed project is located approximately 130 miles south of San Francisco in unincorporated southern Monterey County on the western edge of the Salinas Valley, approximately seven miles west of the City of Greenfield. Paraiso Springs Valley opens into the Salinas Valley on the northern part of broad, sloping alluvial fan create by the Arroyo Seco, a major tributary of the Salinas River (**Figure 1**).

The project site comprises three Parcels (APN 418-361-004, APN 418-381-022, and APN 418-381-021). These encompass about 235 acres in the mouths of the Paraiso Springs Valley and Indian Valley and extend westward up Paraiso Springs Valley into the foothills of the Sierra de Salinas. The site is bordered to the east by grazing and farm land, and to the north, south and west by steep, chaparral-covered slopes of the Sierra de Salinas. Indian Valley and Happy Valley are similar small valleys immediately north and south of Paraiso Springs Valley, respectively.

Paraiso Springs Valley is drained by an unnamed stream channel that crosses the project site. This channel conveys runoff from a 1.6-square-mile watershed as well as water from the hot spring which it has done for over 100 years of hot springs use. After leaving Paraiso Springs Valley, the creek flows eastward through developed drainage ditches that ultimately discharge into Arroyo Seco.

3. HYDROGEOLOGIC SETTING

Paraiso Springs Valley is located in the piedmont area between the Sierra de Salinas—which is the easternmost major ridge of the Santa Lucia Range—and the Salinas Valley. It is one mile long by up to one-fourth mile wide and drains eastward into the much larger Salinas Valley. The valley floor is underlain by unconsolidated sandy deposits and is bounded to the north, west and south by steep hill slopes composed of denser bedrock material.

3.1. TOPOGRAPHY

Figure 2 also shows the topography of the project site and surrounding area. Paraiso Springs Valley slopes from approximately 1,300 feet above sea level at the western end of the valley to around 900 ft near the confluence of Paraiso Springs and Indian Valleys. The watershed tributary to the valley rises steeply to the west, reaching a maximum elevation of 3,100 ft.

3.2. GEOLOGY

A geologic map of the region surrounding Paraiso Springs Valley is show in Figure **3.** Situated on the east flank of the Sierra de Salinas mountains, the project site is underlain at depth by Pre-Cretaceous Sierra de Salinas Schist and Cretaceous age Salinian Block granitic rocks. Overlying the granitic rocks is a series of folded and faulted Tertiary age (Oligocene to middle Miocene) sandstones, conglomerates, and volcanics. The Miocene Tierra Redonda Sandstone crops out and forms the ridges immediately north, south, and west of the valley. The pre-Cretaceous basement complex rocks crop out farther west in the foothills (Dibblee, 1974). In general, the watershed tributary to Paraiso Springs Valley is underlain by deeply dissected bedrock and landslide deposits, while the valley is underlain by unconsolidated to semi-consolidated Quaternary alluvium. The thickness of the alluvium increases from a few feet along the perimeter of the valley floor to around 100 feet along the centerline of the valley.

Several geologic faults occur adjacent to and within Paraiso Springs Valley. An unnamed north-south oriented fault affecting only bedrock is located just beyond the western end of the valley. The much larger Reliz fault is the structural boundary between the Sierra de Salinas and the Salinas Valley. It is oriented approximately north-south and located about one mile east of Paraiso Springs Valley. The Reliz fault might offset alluvial deposits and affect groundwater gradients, although this has not been confirmed locally.

3.3. SOILS

The Soil Survey of Monterey County, California indicates that 12 soil types occupy one percent or more of the Paraiso Springs Valley watershed, as shown on the map in **Figure 4**. Physical characteristics of the soil types are listed in **Table 1**. Three soil types each cover about a third of the valley floor. Stony fluvents are coarse, well-drained soils derived from stream channel deposits. These occupy the western end of the valley. Arroyo Seco gravelly sandy loam is also a relatively coarse and well-drained soil that occupies a broad band roughly following the creek channel. Cropley silty clay is a finer-grained, less permeable soil that occupies the southeastern part of the valley.

Soils on the steep slopes of the tributary watershed are thin. The depth to bedrock ranges from 11 to 55 inches, with an area-weighted average depth of 22 inches. Bedrock restricts the rooting depth of vegetation. Soil moisture storage capacity and annual vegetation evapotranspiration are consequently smaller than for deeper soils. Most of the watershed is covered by soils with moderate to high runoff potential (hydrologic groups B, C and D).

Table 1. Soils in the Paraiso Springs Valley Watershed

Map Label	Name	Slope Percent	Area (acres)	Percent of area	Depth to Bedrock (in)	Available Water Capacity (in/in)	Hydro-logic Group
CcG	Cienega fine gravelly sandy loam	30-50	391.3	38.9%	11	0.1	C
AaE,F	Alo silty clay	30-50	157.5	15.6%	36	0.15	D
SoG	Sheridan coarse sandy loam	30-75	124.2	12.3%	39	0.07	B
Sg	Santa Lucia - Reliz association	30-75	116.1	11.5%	24	0.12	C
Jc	Junipero - Sur complex	50-85	89.0	8.8%	30	0.13	B
Xd	Xerorthents	50-65	43.6	4.3%	>60	0.13	D
SdF	San Benito clay loam	30-50	26.6	2.6%	55	0.19	B
CnC	Cropley silty clay	2-9	17.1	1.7%	>60	0.15	D
LmG	Los osos clay loam	50-75	12.4	1.2%	31	0.17	C
Fa	Fluvents, stony	0-15	12.1	1.2%	>60	0.04	A
AsC	Arroyo Seco gravelly sandy loam	5-9	9.8	1.0%	>60	0.07	B
PnD	Placentia sandy loam	9-15	6.3	0.6%	>60	0.04	D
SfF	Others	--	0.7	0.1%	--	--	--

3.4. RECHARGE AREA

Rainfall recharge occurs over the entire watershed. On the valley floor, deep percolation past the root zone accrues directly to groundwater in the alluvial aquifer. Infiltration into the relatively thin soil mantle that covers the steep slopes of the tributary watershed flows downslope through the soil zone or bedrock fractures until it reaches the bottom of one of the tributary canyons. From there it flows toward Paraiso Springs Valley as visible base flow in the creek channels at some times and locations, but primarily as subsurface flow. This drainage of rainfall infiltration in the tributary watershed area is the largest source of recharge to the alluvial aquifer, as described below in the section on “Water Balance”.

3.5. PREVIOUS GROUNDWATER INVESTIGATIONS

Numerous geologic and hydrologic investigations of the Salinas Valley have been completed over the past century by federal, state and county agencies. Most of these studies were regional in extent, focusing on water resources for the entire Salinas Valley. Previous studies of hydrogeology and water resources in Paraiso Springs Valley were all prepared as initial studies for the Project and listed above under “Data Sources”. The investigations most relevant to the present analysis were:

- A geologic investigation by LandSet Engineers (2004) that included test borings in the valley floor and adjacent hillsides.
- Video logging and a 10-day pumping test of Well #1 and Well #2 in accordance with County guidelines for water supply wells (CH2M HILL, Inc., 2008a). During those tests, CH2M Hill also collected and analyzed groundwater samples from each well for water quality characteristics. The samples were analyzed for a comprehensive suite of analytes including general mineral chemistry and potential contaminants. CH2M Hill identified elevated fluoride concentrations in one sample, and recommended treatment using activated alumina to reduce fluoride concentrations to drinking water standards.
- An evaluation of stormwater runoff and erosion potential (CH2M HILL, Inc., 2008b).
- Detailed estimates of water demand for resort facilities (CH2M HILL, Inc., 2010a).
- Estimates of wastewater generation, irrigation demand, and recycled water storage and use for irrigation (CH2M HILL, Inc., 2010b).

4. HYDROMETEOROLOGICAL SETTING

The climate of the Salinas Valley is Mediterranean, with relatively moderate temperatures and distinct wet and dry seasons. This section describes climate data that are used in subsequent sections to evaluate the water balance of the alluvial aquifer and water demand for the Paraiso Springs Resort project.

4.1. RAINFALL

Available sources of precipitation data produce different estimates of average annual rainfall in Paraiso Springs Valley and the surrounding watershed. Paraiso Springs Valley is located approximately midway between National Oceanic and Atmospheric Administration rain gages at Soledad and Paloma. The latter station is located west of Paraiso Springs Valley, higher up in the Arroyo Seco watershed. Average annual rainfall during water years 1956-1982 was 10.84 inches at Soledad and 23.81 inches at Paloma. If rainfall increases uniformly between the stations, average annual rainfall should be approximately 17 inches in Paraiso Springs Valley and 18 inches as an area-weighted average for the watershed tributary to the valley. An isohyetal map produced by Monterey County Water Resources Agency (1997) had an anomalously steep rainfall gradient in the vicinity of Paraiso Springs Valley and a value of 28 in/yr at the Paloma gage site, which is substantially greater than the average of historical measurements. An isohyetal map produced by the U.S. Geological Survey has values of 15 inches per year at Paraiso Springs Valley and 22 in/yr at Paloma, which are more consistent with the NOAA rain gage data. The intermediate estimates of 17 in/yr in the valley and 18 in/yr for the local watershed are used in this analysis.

Over 83 percent of annual rainfall typically falls during November-March, and the total amount varies substantially from year to year. For example, annual rainfall at Soledad ranged from 5.5 inches in water year 1977 to 19.9 inches in water year 1983.

4.2. EVAPORATION

Most rainfall infiltrates into the soil and is consumed by plant evapotranspiration (ET). The ET is a function of meteorological factors, vegetation type and leaf canopy coverage. The meteorological factors vary considerably over short time intervals (hours to months) but are much more uniform from year to year than rainfall. The vegetation factors are expressed in relation to a standard reference crop, which is a large patch of well-watered grass. Reference ET (ETo) is measured by California Department of Water Resources' CIMIS program at numerous locations around the state, including one near Soledad (Station #114, Arroyo Seco). Annual ETo averages 51.37 inches at the station, of which 77 percent occurs during April-October. ETo increases by 8.6 inches per year for every 1,000 feet of elevation in California (Blaney, 1958; Longacre and Blaney, 1962). Assuming this relationship holds true on the eastern slopes of the Sierra de Salinas, average annual ETo is approximately 55.7 inches at Paraiso Springs Valley and 61.7 inches averaged over the watershed tributary to the valley.

4.3. RUNOFF

Flow in the unnamed creek that flows through Paraiso Springs Valley has never been monitored but is almost certainly ephemeral, which means that surface flow is present only during and for perhaps a few days following a rain storm event. The average number of days of flow per year from five small gaged watersheds in the Salinas Valley region ranged from 6 to 237, generally increasing with drainage area[2] . Based on those data, a reasonable estimate for Paraiso Springs Valley creek is 20 days of flow per year. The data were too variable to accurately extrapolate annual total discharge and base flow to the Paraiso Springs Valley creek. However, the approximate flow duration was used to estimate groundwater recharge from creek percolation in Section 8 "Groundwater Balance".

A reach of the creek channel in Paraiso Springs Valley has perennial flow created by discharge from the hot springs. For over a century of hot springs use, hot spring discharge has been routed through bathing pools and then discharged to the creek. Except during rain storm events, the creek is dry upstream of the discharge point, and the small discharge (30-40 gallons per minute, or about 0.07 cubic feet per second) percolates entirely into the creek bed over a wetted reach that extends to approximately the downstream boundary of the resort property. In recent decades, the largest and lowermost pool has been chlorinated to meet public health requirements. There are no obvious signs that the chlorine in the discharged water adversely impacts aquatic biota in the flowing reach, and the oxidizing capacity of the chlorine would be rapidly neutralized as it seeps into the ground.

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[2] The five gages were: Willow Creek Tributary near San Benito, Santa Rita Creek Tributary near Templeton, Cow Creek near San Ardo, Alisal Creek near Salinas and Jack Creek near Templeton.

5. SURFACE WATER RESOURCES

The valley floor area of Paraiso Springs Valley contains wet areas that have been delineated as wetlands by the U.S. Army Corps of Engineers. A total of 0.71 acres of freshwater marsh, riparian wetland and seasonal wetland that may be considered jurisdictional under Section 404 of the Clean Water Act were delineated in the Study Area (WRA, 2016). Most of the wetlands are located in depressions in the eastern half of the valley where the water table locally approaches or intersects the ground surface. These areas support freshwater marsh species. In the western half of the valley, the water table is farther below the ground surface and surface water is present only in the creek channel during large rain events. Vegetation along the main creek channel was not mapped as wetlands.

A spring at the eastern edge of the Paraiso Springs Resort property generates a small amount of surface flow from which a neighbor (Pura Ranch) has an easement to divert as much as can be conveyed in a 1-inch pipe, limited to normal residential use for two parcels and the watering of livestock.

6. GROUNDWATER RESOURCES

At a regional scale, groundwater flows east out of bedrock units in the Sierra de Salinas and enters the alluvial deposits of the Salinas Valley as subsurface inflow or as percolation from streams. The unconsolidated alluvial deposits are much more permeable than the Tertiary sedimentary deposits that crop out in the piedmont area and plunge beneath the Salinas Valley, such as the Tierra Redonda, Pancho Rico and Monterey Formations. However, those formations are sufficiently permeable that they are also tapped for domestic water supplies, for which high-yielding wells are not necessary. As a case in point, the Project has two supply wells, one of which is screened in the alluvium (Well #1 or "Main Well"), and one of which is screened in the Tierra Redonda Formation (Well #2 or "Fluoride Well"). The locations of these wells, the Paraiso Spring, and domestic wells and springs on nearby parcels are shown in **Figure 5.** Other wells are present within the mapped area shown, but based on parcel location none are closer to the Project site than the ones on the map.

6.1. AQUIFER CHARACTERISTICS

In order to estimate the sustainable yield of the supply wells and estimate aquifer hydraulic properties, 10-day pumping tests were conducted on Wells #1 and #2 (CH2M Hill, 2008a). Well #1 is completed to a depth of 104 feet below ground surface (ft bgs) and screened predominantly in the alluvial aquifer. Well #2 is completed to a depth of 763 ft bgs and presumably screened in the sedimentary rock aquifer (**Table 2**).

Table 2. Project Supply Well Construction and Hydraulic Performance Information

Well Name	Total Depth (ft)	Screen Interval(s) (ft bgs)	10-Day Pumping Test flow Rate (gpm)	Specific Capacity (gpm/ft)	Aquifer Transmissivity (gpd/ft)	Aquifer Transmissivity (ft^2/day)	Hydraulic Conductivity (ft/day)
Well #1 (Main Well)	104	45.5 - 100.8	58.5	4.5 - 22	6750	902	34
Well #2 (Fluoride Well)	763	multiple perforated zones from 115 to 763	334.8	4.5	9000	1203	2.3

Source: CH2M HILL (2010a)

ft - feet	ft bgs - feet below ground surface
gpm - gallons per minute	gpm/ft - gallons per minute per foot
gpd/ft - gallons per day per foot	ft^2/day - square feet per day
ft/day - feet per day	

The pumping rates and amounts of drawdown were recorded during the tests. The tests were conducted at average rates of 58.5 and 334.8 gallons per minute (gpm) for Wells #1 and #2, respectively, and the total drawdowns were 13 and 74 feet. The corresponding specific capacities for the two wells were 4.5 to 22 gpm/foot for Well #1 and 4.5 gpm/foot for Well #2.

Using the specific capacity for Well #1, the transmissivity of the alluvial aquifer is estimated to be 902 square feet per day. Using an alluvial aquifer saturated thickness of 26.3 feet (the difference between the final depth to water and the depth to the alluvial/rock aquifer contact), the estimated alluvial aquifer hydraulic conductivity is 34 feet per day.

An independent review of the aquifer test questioned procedural issues (change in pumping rate; relocation of the well discharge line) that impacted the accuracy of the calculated transmissivity (Balance Hydrologics, Inc., 2016). Re-evaluation of the early-time drawdown data indicated a transmissivity as low as 165 ft^2/d, or only 18 percent as large as the original estimate. This estimate is almost certainly too low because the pumping rate during that part of the test was unsustainably high and drawdown had reached a point that it could have decreased flow to the well. Throughout the remainder of this report the original estimates of transmissivity and hydraulic conductivity are used. However, even if the smaller estimates were used the estimated groundwater balance would still be more than adequate to support the project, including potential mitigation measures and during droughts.

6.2. GROUNDWATER LEVELS AND FLOW

Groundwater depths were measured in the onsite production wells and in 28 soil borings drilled at the site in August 2004 by LandSet Engineers (2004). Groundwater was encountered at depths ranging from 11 to 55 feet below the ground surface. In the proximity of the hot springs, the depth to groundwater ranged from 11 to 18.5 feet below the ground surface. West of the hot springs, the depth to groundwater was 18.5-55 feet.

Using the estimated ground surface elevations at well and soil boring locations (**Table 3**), groundwater elevations were calculated and used to develop a water table contour map for the alluvial aquifer (**Figure 5**). In the alluvial aquifer, groundwater elevations range from 1,133 feet above mean sea level (ft amsl) in Well #1 to 1,005 ft amsl in Boring B-1, in the eastern portion of the Valley. The hydraulic gradient in the eastern portion of the valley is around 0.12 foot/foot. The water table gradient down the valley is nearly flat at an elevation of about 1,130 feet between Well #1 and Paraiso Spring. This could be the result of inflow of hydrothermal water into the basin near the spring. The groundwater elevation in Well #2 could reflect an upward flow gradient, noting that Well #2 is screened entirely below the alluvium, to a depth of 763 feet. The groundwater elevation in 2004 was 84 feet higher than the elevation in Well #1 and resulted in a very steep water-level gradient when it was included in the contouring for the alluvial aquifer (see **Figure 5**).

The rate of groundwater flow through the alluvial aquifer was estimated using the Darcy Equation, which calculates groundwater flow as the product of aquifer cross-sectional area, hydraulic conductivity and water-level gradient. The aquifer was assumed to have a triangular cross section consistent with projecting the adjacent hill slopes into the subsurface beneath the valley floor. The estimated average width was 525 feet, and the estimated saturated thickness at the deepest point was 80 feet. The hydraulic conductivity estimated from well specific capacity data was 34 feet per day (see Table 3). The water-table gradient down the valley obtained from contouring borehole water levels in the eastern half of the valley averaged about 0.121 foot per foot in 2004 (**Figure 5**). These factors produce a flow estimate of 733 AFY.

Table 3. Groundwater Depth and Elevation in Borings and Wells

Date	Well/Boring Number	Boring/Well Depth (ft)	Initial Depth to Water (ft)	Depth to Water after 30 mins (ft)	Approximate Ground Surface Elevation (ft amsl)	Approximate Groundwater Elevation (ft amsl)	Geology/Comment
Aug-04	B-1	45	18.5	6.5	1012	1005.5	
Aug-04	B-2	21.5	>21.5		1120		
Aug-04	B-3	30	15	19	1046	1027	
Aug-04	B-4	21.5	>21.5		1083		
Aug-04	B-5	40	21	11.5	1100	1088.5	
Aug-04	B-6	21.5	>21.5		1150		
Aug-04	B-7	55	11	8	1127	1119	
Aug-04	B-8	21.5	>21.5		1155		
Aug-04	B-9	30	12	7	1136	1129	
Aug-04	B-10	10.5	>10.5		1061		Tierra Redonda at 5' depth.[1]
Aug-04	B-11	46.5	18.5	18.2	1150	1131.8	
Aug-04	B-12	15.5	>15.5		1110		Tierra Redonda at 5' depth.[1]
Aug-04	B-13	50	12	9.7	1133	1123.3	
Aug-04	B-14	26.5	>26.5		1155		Tierra Redonda at 5' depth.[1]
Aug-04	B-15	18.75	>18.75		1160		Granite at 11' depth.[1]
Aug-04	B-16	16.5	>16.5		1200		Tierra Redonda at 5' depth.[1]
Aug-04	B-17	50	31.5	41.3	1167	1125.7	
Aug-04	B-18	16.5	>16.5		1225		
Aug-04	B-19	60	55	58.3	1188	1129.7	Tierra Redonda at 5' depth.[1]
Aug-04	B-20	16.5	>16.5		1217		Granite at 13' depth.[1]
Aug-04	B-21	24	>24		1225		Tierra Redonda at 11' depth.[1]
Aug-04	B-22	10.5	>10.5		1318		Tierra Redonda at 1' depth.[1]
Aug-04	B-23	39.5	14	5.5	1075	1069.5	Tierra Redonda at 34' depth.
Aug-04	B-24	21.5	>21.5		1310		
Aug-04	B-25	21.5	>21.5		1250		
Aug-04	B-26	19.5	>19.5		1193		Tierra Redonda at 9' depth.[1]
Aug-04	B-27	6.5	>6.5		1230		Tierra Redonda at 3' depth.[1]
Aug-04	B-28	5.5	>5.5		1236		Tierra Redonda at 3' depth.[1]
Nov-07	Well #1			68.7	1202	1133.3	"Rock" at 95' depth.
Nov-07	Well #2			3	1220	1217	

Source: LandSet Engineers (2004).

ft - feet ft amsl - feet above mean sea level

[1] Borehole located on ridge outside of the alluvial groundwater basin

6.3. GROUNDWATER STORAGE

The Project overlies approximately 55 acres of alluvial groundwater basin, although alluvium along the edges of the valley is mostly above the water table. Assuming a specific yield of 0.15, the groundwater storage capacity of the alluvium is 200-400 AF, depending on whether the alluvial cross section is interpreted as triangular versus rectangular. Well #2 extends 763 feet into the Tierra Redonda Formation, which provides considerably more storage capacity. The saturated thickness is ten times greater than the thickness of the alluvial aquifer, and the area over which Well #2 could potentially draw from storage during a drought is about five times greater. The specific yield is undoubtedly less than in the alluvium—perhaps by a factor of ten—but that still leaves a storage capacity several times greater than is available in the alluvium. A reasonable estimate of overall storage capacity is 1,000 AF, which is twenty-four times the annual groundwater pumping for the Project at buildout with 70 percent average occupancy and twenty times the annual pumping at full occupancy (see Section 8 "Water Balance"). During a multi-year drought, groundwater inflow to Paraiso Springs Valley from bedrock in the tributary watershed area would gradually decline, but not to zero. With access to the remaining inflow and the large amount of groundwater storage capacity, Wells #1 and #2 would provide a reliable, drought-proof water supply for the project.

6.4. GROUNDWATER QUALITY

The two supply wells were sampled during December 2007, and the samples were submitted to BSK Analytical Laboratories, a California-certified laboratory, for analysis of US EPA and CCR Title 22 drinking water parameters. The analytical results are included in CH2M Hill, 2008. In general, the groundwater quality from both wells is similar.

The groundwater meets almost all State and Federal Drinking Water Standards. Drinking water standards are called maximum contaminant levels (MCLs). MCLs are found in Title 22 of the California Code of Regulations (http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Lawbook/DWstatutes-2014-01-01.pdf). The Central Coast Basin Plan (Central Coast Regional Water Quality Control Board, 2011) includes water quality objectives for groundwater. Paraiso Springs Valley is in the "Upper Forebay" subarea of the Salinas Valley, for which the total dissolved solids (TDS) objective is 800 milligrams per liter (mg/L) and the nitrate objective is 5 mg/L as nitrogen.

MCLs include Primary MCLs (PMCLs), that are health-based water quality criteria, and secondary maximum contaminant levels (SMCLs). Elevated levels of constituents exceeding SMCLs can make potable use undesirable for aesthetic rather than health reasons.

In general, the groundwater in Paraiso Springs Valley is acceptable for both potable and irrigation uses. The groundwater is moderately hard (i.e., high in calcium carbonate). The concentration of total dissolved solids was 890 mg/L in Well #1 and 858 mg/L in Well #2. These values are between the lower SMCL (500 mg/L) and upper SMCL (1,000 mg/L) for drinking water.

The fluoride levels in Wells #1 and #2 were 2.8 and 9.1 mg/L; the PMCL for fluoride is 2 mg/L. In order to meet Drinking Water Standards, water produced from the wells will be treated using an activated alumiuna system to reduce flouride concentrations to below the PMCL.

The nitrate concentration (as N) was 1.2 mg/L in Well #1, and nitrate was not detected (ND) in Well #2. The PMCL for nitrate-nitrogen is 10 mg/L.

No pesticides or volatile organic compounds were detected in the samples from the two wells. All other analytes were below PMCLs and SMCLs.

To help characterize pre-project water quality at the Paraiso spring used by the Pura Ranch, the resort collected a water quality sample on June 20, 2016. The concentrations of several constituents did not meet drinking water standards. Coliform bacteria including *e. coli* were reported as “present”. The primary drinking water standard requires that total coliform and *e. coli* be absent. The fluoride concentration was 9 mg/L, which is several times greater than the primary drinking water standard. High fluoride is unusual in groundwater derived purely from rainfall recharge. This result suggests that spring water quality is affected by the hydrothermal waters that enter the alluvial groundwater basin upgradient at the Hot Spring well. The Paraiso spring used by the Pura Ranch has sodium-sulfate type water, and the sulfate concentration (561 mg/L) is more than twice the secondary drinking water standard. Also, the total dissolved solids concentration (1,090 mg/L) slightly exceeds the upper long-term secondary drinking water standard.

Currently, that spring serves two residences. Historical agreements allow diversions up to the amount of flow that will pass through a 1-inch pipe, to be used for normal domestic purposes only at the two residences and the watering of livestock at one residence. However, the water quality test results decribed above do not meet primary drinking water standards and therefore the spring water is not suitable for domestic potable use without treatment.

7. WATER DEMAND AND SUPPLY

Indoor water demand for each of the four Project development phases was estimated by CH2M Hill (2010a). The demand calculations used water demand factors for hotel rooms, homes, restaurants, and spa and other resort facilities developed by Monterey Peninsula Water Management District (2012). The CH2M HILL calculations produced an annual demand of 34,400 gallons per day (gpd), assuming average annual occupancy at buildout. The assumed “average” and “high” occupancy levels are both less than 100 percent occupancy for several reasons:

- Resorts and hotels never achieve 100 percent occupancy for prolonged periods of time. The Monterey County Environmental Health Bureau considers full occupancy for this project to be 85 percent for hotel rooms, 100 percent for time-share condominiums and villas, and 100 percent for all other resort facilities (85-100-100 occupancy). This level of occupancy could occur for short periods of time and is an appropriate assumption for evaluating the capacity of water production, distribution and wastewater treatment infrastructure.
- For longer averaging periods—such as 6 months to one year—the Monterey County Planning Department has indicated that average occupancy of 70 percent of hotel rooms, 85 percent of time-share dwellings and 85 percent of all other facilities is reasonable (70-85-85 occupancy). This longer-term average occupancy is appropriate for evaluating seasonal effects on the groundwater balance.

Water use and wastewater generation and disposal were estimated for Phase 1 and final buildout of the proposed development under the 85-100-100 and 70-85-85 occupancy assumptions. **Table 4** shows the monthly tabulation of water, wastewater and irrigation for the buildout phase under the 70-85-85 occupancy assumption appropriate for evaluation of seasonal recycled water storage requirements. Tables showing results for Phase 1 and Buildout under both occupancy assumptions are in **Appendix A**. Data items displayed in the tables are described below.

Irrigation water use for the project would be slightly higher at buildout than during Phases 1 through 3. During the first three phases, it would be determined by the amounts and types of vegetation specified in the site plan and efficient irrigation at normal agronomic rates for each type of vegetation. Recycled water supply would be less than the total irrigation demand, and the balance would be provided as groundwater from the Project supply wells. At buildout, the annual recycled water supply would slightly exceed the irrigation amounts applied during Phases 1 through 3. However, a small increase in the application rate for turf would fully utilize the recycled water supply without exceeding the range of agronomically appropriate irrigation rates for turf. The following paragraphs present the details of the irrigation water balance.

Table 4. Monthly Recycled Water and Irrigation Operations: Buildout, 70-85-85 Occupancy

Flow or Storage	Assumed Occupancy	Volumes in Acre-Feet												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Irrigation Demand														
Turf		0.3	0.4	1.3	2.5	3.5	4.0	4.0	3.8	2.7	1.9	0.7	0.1	25.2
Vineyard		0.0	0.0	0.7	2.0	0.3	0.7	1.0	0.3	0.7	0.0	0.0	0.0	5.6
General landscaping		0.0	0.0	0.0	0.1	0.6	1.6	1.2	1.3	0.6	0.4	0.1	0.0	5.8
Total		0.3	0.4	2.0	4.6	4.4	6.4	6.2	5.4	3.9	2.2	0.8	0.1	36.7
Recycled Water Supply														
Hotel	70%	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.6
Condos and villas	85%	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	17.7
All other facilities	85%	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.4
Water treatment backflush		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.9
Total		3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	36.7
Wastewater and Irrigation Operation with Reservoir Storage														
Recycled water to irrigation		0.3	0.4	2.0	3.1	3.1	3.1	3.1	3.1	3.1	2.2	0.8	0.1	24.2
Recycled water to storage		2.8	2.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.2	2.9	12.5
Irrigation from storage		0.0	0.0	0.0	1.5	1.3	3.3	3.1	2.3	0.9	0.0	0.0	0.0	12.5
Recycled water percolation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycled water in storage		8.8	11.5	12.5	11.0	9.6	6.3	3.2	0.9	0.0	0.8	3.0	6.0	--
Groundwater to irrigation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

Potable water use (acre-feet per year):	38.6
Recycled water storage capacity (Mgal):	4.1

Irrigation demand on the Project site was estimated using the soil moisture budget spreadsheet model that was also used to estimate rainfall recharge. Three types of vegetation would be irrigated for the project, and their acreages during Phases 1 through 3 would be as follows: turf (8.5 acres), vineyard (6.8 acres) and "general" drought-tolerant landscaping (8.5 acres). For turf, a crop coefficient of 0.7 was used, which is the WUCOLS water use factor for turf. The "Water Use Classification of Landscape Species" (WUCOLS) factors are crop water use coefficients compiled by the University of California and the California Department of Water Resources (2000) in support of the State's model water efficient landscape ordinance. Irrigation return flow was assumed to equal 20 percent of applied water, which is reasonable for sprinkler-irrigated turf. This resulted in an average annual irrigation amount of 22.7 AFY for the turf during Phases 1 through 3 (see **Table A-1** in **Appendix A**). At buildout under average occupancy, turf irrigation would be increased to 25.2 AFY in order to fully consume the annual supply of recycled water (**Table 4**). This corresponds to a WUCOLS factor of 0.78, which is within the agronomically reasonable range for turf. In the unlikely event that the resort were at high occupancy continuously for a year, the additional recycled water could still be consumed by increasing the irrigation rate on the turf up to a WUCOLS factor of 1.0. A plant factor of 1.0 corresponds to reference evapotranspiration, which is the amount of water transpired by well-watered turf. The turf area would be lusher than under normal irrigation, but it would consume the additional water without runoff or increased groundwater recharge.

Irrigation of commercial vineyards depends on row spacing, canopy pruning, and whether regulated deficit irrigation is implemented to improve berry quality. A recent field study of vineyard irrigation practices in the Paso Robles area revealed substantial variability among vineyards but developed the following empirical equation relating annual applied water to annual rainfall (Battany, 2013):

$$\text{Applied Water} = -0.2756\ (\text{Annual Rainfall}) + 14.481$$

where applied water and annual rainfall are in inches. Annual rainfall in Paraiso Springs Valley averages 17 in/yr, which corresponds to an applied water rate of 9.8 in/yr, or 5.6 AFY for the proposed 6.8-acre vineyard. The vineyard would be drip irrigated, with an assumed irrigation efficiency of 95 percent.

Other irrigated landscaping at the resort would consist of drought-tolerant species. An average WUCOLS plant factor for plants in that category is 0.3. These plants were assumed to be drip irrigated, with an irrigation efficiency of 95 percent. These assumptions resulted in simulated average annual irrigation of 8.3 in/yr, or 5.8 AFY for the proposed 8.5 acres of irrigated vegetation.

Total annual irrigation demand for the Project would be 36.7 AFY at buildout with 70-85-85 average occupancy. All of this demand would be met using recycled wastewater with seasonal storage provided by an underground reservoir. The monthly generation of recycled water from each water use category was estimated from their respective water demand factors by assuming that occupancy is uniform throughout the year and that 90 percent of water distributed through the potable supply system becomes wastewater and is recycled for irrigation use. During Phases 1 through 3, the same irrigated areas would require only 34.1 AFY of irrigation because the recycled water supply would be less than the base level of irrigation demand for those areas (**Table A-1**).

The bottom section of **Table 4** shows monthly recycled water storage and irrigation supply. In months with irrigation demand, some or all of the recycled water produced that month would go directly to irrigation use. This would amount to 24.2 AFY at buildout with 70-85-85 occupancy. During October-March recycled water generation would exceed irrigation demand, and recycled water would be stored in the underground reservoir. A total of 12.5 AFY of recycled water would be diverted to storage and subsequently used for irrigation during April-September. For this scenario, the required recycled water storage capacity was 4.1 million gallons (mgal).

The water supply for the Project would be the two existing wells on the Project site, near the upstream end of the valley. Well #1 (Main Well) and Well #2 (Fluoride Well) were subjected to a 10-day yield test in accordance with Monterey County guidelines and were approved as reliable to meet demands of up to 29.3 gpm and 167 gpm, respectively (CH2M HILL, Inc., 2008a) . Peak groundwater demand would occur in June during Phase 1. Irrigation demand is much more seasonal than indoor water demand, and a higher percentage of irrigation demand is met by groundwater during Phase 1 than during subsequent phases. The peak demand in June would be equivalent to 33 gpm, or 17 percent of the credited well capacity. The County approved both wells for only half of their normal pumping rates. This is the County's standard practice for bedrock wells. Alluvial wells are normally credited with 100 percent of their demonstrated capacity, so the alluvial well should have been credited for 58.6 gpm. Thus, if the larger well abruptly malfunctioned and had to be removed from service, the smaller well would be physically capable of supplying the entire Project demand on an interim basis during repairs of the larger well.

8. GROUNDWATER BALANCE

The water balance of the Paraiso Springs Valley groundwater basin was estimated under existing conditions and with the proposed resort development to determine whether changes in the water balance could impact local wetland habitats, neighboring groundwater users, and water resources of the overall Salinas Valley. A water balance is a systematic tabulation of inflows, outflows and change in storage in a groundwater basin. Average annual water balances under existing and Project buildout conditions with average occupancy are shown in **Table 5**, plus a monthly breakdown of the Project water balance. The derivation of individual items is described below. Note that entries in the table are shown to the nearest tenth of an acre-foot in order to include small items in the water balance. In reality, entries should not be considered accurate to more than two significant digits.

8.1. EXISTING CONDITIONS

8.1.1. Inflows

Rainfall recharge on the valley floor was estimated using a daily soil moisture budget spreadsheet model. The model simulates runoff, infiltration, plant evapotranspiration, irrigation (if present), and deep percolation (groundwater recharge). The simulation is applied to defined zones of soil and vegetation type. Nine vegetation communities have been identified in Paraiso Springs Valley (WRA, 2016), but for the purposes of recharge analysis, the valley floor vegetation was divided into trees (predominantly coast live oak) and annual grasses. Field studies of soil moisture for similar vegetation near Lompoc in Santa Barbara County found that oak trees extract soil moisture to depths of up to 18 feet and grasses and weeds to depths of up to 8 feet (Blaney and others, 1963). Water percolated past the root zone in only two of the five years of data collection, when annual rainfall exceeded 18 inches. In intervening dry and normal years, trees and shrubs tended not to use all available soil moisture in any year. Instead, the minimum soil moisture content at the end of the dry season progressively declined from year to year until a wet year fully replenished the soil moisture profile. Annual grasses exhibit a different water use strategy, consuming essentially all available soil moisture within their relatively shallow rooting depth before going dormant sometime in summer.

The soil moisture budget in the valley floor was simulated using an available water capacity of 0.13 inches per inch, runoff commencing at 0.4 inches of daily rainfall, infiltration capturing 90 percent of rainfall above that threshold, and root depths of 2 and 18 feet for grasses and trees, respectively. Daily soil moisture was simulated for water years 1994-2013 using a time series of rainfall from the King City station and a time series of reference ET from the CIMIS Arroyo Seco station. The two time series were scaled by multipliers to match the corresponding long-term average annual values at Paraiso Springs Valley. Crop coefficients of 1.0 for grasses and 0.35 for trees were used. The coefficient for grass reflects the tall stature of unmown annual grasses compared to reference ET turf. The coefficient for trees resulted in deep percolation only in years with 18 inches of rainfall or more, consistent

Table 5. Monthly Groundwater Balances under Project Conditions: Buildout, 70-85-85 Occupancy

Inflow or Outflow Item	Existing Conditions	Project Conditions	Monthly Flow or Storage (acre-feet)												Total
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Inflows															
Rainfall and irrigation deep percolation															
Nonirrigated areas	22.8	1.4	0.3	0.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Irrigated areas	0.0	22.7	0.9	1.3	1.7	0.4	2.6	3.1	4.0	4.0	2.8	1.8	0.0	0.0	22.7
Impervious areas	0.0	24.7	4.9	7.4	9.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7
Stream percolation	7.2	7.2	1.4	2.2	2.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
Groundwater inflow from hillslope recharge	710.2	710.2	49.2	59.2	69.2	76.5	79.2	76.5	69.2	59.2	49.2	41.9	39.2	41.9	710.2
Hydrothermal groundwater inflow	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Wastewater percolation	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total inflows	796.9	822.6	61.4	75.2	88.9	85.0	86.5	84.3	77.9	67.9	56.6	48.4	43.9	46.6	822.6
Outflows															
Well pumping															
Indoor uses	0.2	38.6	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	38.6
Irrigation															
Turf	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vineyard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
General	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water treatment	0.0	1.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.9
Spring discharge (Hot Spring well)	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Evapotranspiration															
Freshwater marsh	1.8	1.8	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.0	0.0	1.8
Riparian wetland	0.5	0.5	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.5
Seasonal wetlands	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Net evaporation from ornamental pond and small recirculating water features	0.0	1.1	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	1.1
Groundwater outflow	737.7	722.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	722.2
Total outflows	796.9	822.6	68.3	68.3	68.3	68.7	68.8	68.9	68.9	68.8	68.7	68.6	68.3	68.3	822.6
Inflows - outflows	0.0	0.0	-6.9	6.9	20.7	16.3	17.6	15.5	9.1	-0.9	-12.1	-20.2	-24.4	-21.7	0.0
Cumulative groundwater storage change	0.0	0.00	6.92	13.83	34.51	50.76	68.41	83.87	92.94	92.07	80.02	59.85	35.47	13.77	
Seasonal water-level fluctuation (ft)															10.4

Notes:

Total groundwater pumping (AFY)	40.6
Change in groundwater outflow (AFY)	-15.5

with the studies by Blaney and others (1963). The coefficients are reasonable compared to with the studies by Blaney and others (1963). The coefficients are reasonable compared to the WUCOLS water use factors, given that the coefficients include wet season ET, not just irrigation season ET.

The resulting estimates of average annual rainfall recharge in the valley floor area were 6.5 in/yr for grassland and 2.2 in/yr for trees. Grassland occupies approximately 67 percent of the valley floor (37 ac) and trees occupy the remainder (18 ac). Multiplying those areas by their respective recharge rates obtains an estimate of 22.8 AFY of rainfall recharge on the valley floor.

There is no irrigation in the valley at present, and consequently no irrigation return flow. The amount of impervious area is also negligible, and runoff from impervious surfaces infiltrates into adjacent pervious soils and is retained in the soil moisture system.

Groundwater recharge from stream percolation occurs during the brief season of flow in the creek. The channel is narrow (averaging about 2 feet), and the reach through Paraiso Springs Valley is approximately 2,300 feet long. Assuming the vertical hydraulic conductivity of the creek bed and surficial aquifer materials equals one-tenth the horizontal hydraulic conductivity (or 3.4 ft/d) and that the flow season averages 20 days per year, the creek would generate approximately 7 AFY of recharge. This assumes that the creek bed is sufficiently high above the water table to not be influenced by the water table elevation, which is a reasonable assumption along at least most of the channel.

The largest source of recharge is groundwater inflow from the tributary watershed. The amount of inflow was estimated by two different methods, both of which produced similar results. The first method was the calculation of groundwater flow through the alluvial aquifer using the Darcy Equation described in Section 6.2 “Groundwater Levels and Flow”. This flow of 733 AFY was calculated for the downgradient end of the basin and therefore includes rainfall recharge on the valley floor. Subtracting that source of recharge leaves an estimated 710 AFY of groundwater outflow derived from inflow from the tributary watershed.

The second estimate was obtained by applying the soil moisture budget spreadsheet model to the tributary watershed area. The steep slopes and shallow bedrock result in more runoff and deep percolation and less ET relative to conditions on the valley floor. Root depth was assumed to be limited to the depth of bedrock, which averages 22 inches throughout the watershed. The area-weighted available water capacity of the soils is 0.12 inches per inch. Runoff was assumed to occur with daily rainfall exceeding 0.3 inch, and 80 percent of rainfall above that threshold was assumed to infiltrate. A crop coefficient for the native chaparral vegetation that covers the watershed was assumed to be 0.35, the same value used for oaks in the valley floor area. Applying these values to the soil moisture budget simulation produced an average annual deep percolation of 8.9 in/yr, which equates to 749 AFY for the 1.6-square-mile watershed. This estimate is similar to the first estimate, and to be conservative the smaller of the two estimates is used in **Table 5**.

The hydrothermal water that discharges from Paraiso Springs is a unique local feature of this alluvial groundwater basin. The water derives from deeper bedrock formations and contributes to the available yield of the alluvial aquifer, but there is no standard method for estimating the flow rate. To be conservative, it was assumed that the shallow Hot Springs well that collects the warm water for use in the pools and spas captures 100 percent of the hydrothermal inflow to the alluvial aquifer. The well flows at a constant rate of 30-40 gpm (Geosolutions, 1998). Assuming constant year-round discharge, hydrothermal inflow amounts to 56.5 AFY.

Septic system percolation generated by the two existing residents was assumed to equal 98 percent of their indoor use (California Department of Water Resources, 1983), or 0.2 AFY.

Average annual total inflow to the Paraiso Springs Valley alluvial aquifer is estimated to be 797 AFY.

8.1.2. Outflows

Presently, the only active groundwater pumping for water supply is for domestic use by the two permanentresidents. The residents have no irrigated landscaping, and indoor use is probably on the order of 80 gallons per capita per day. This amounts to 0.2 AFY of groundwater pumping.

The hot spring discharge issues through the Hot Springs well at the aforementioned rate of approximately 56.5 AFY. After flowing through pools and spas, it is discharged to the creek. To avoid counting inflow of hydrothermal groundwater twice, none of the discharge to the creek is assumed to percolate back into the aquifer.

Wetland and phreatophytic riparian vegetation consume water directly from the water table. Three areas of such vegetation were identified in a wetlands inventory of Paraiso Springs Valley (WRA, 2016): 0.51 acre mapped as freshwater marsh, 0.14 acre mapped as riparian wetland, and 0.06 acre mapped as seasonal wetland. Groundwater consumption was estimated as the excess of reference ET over rainfall, summed for the 12 months of the year. A conservatively high estimate of consumptive use was obtained by assuming the plants transpire at the full reference ET rate. The combined consumptive use of groundwater at the three sites is estimated to be 2.5 AFY.

Almost all recharge to the basin leaves as subsurface outflow to the east, where it contributes to the overall groundwater balance of the Salinas Valley. As described above, this outflow was estimated using the Darcy Equation at 733 AFY. This was adjusted upward by 4.7 AFY (0.6 percent) so that total outflows equaled total inflows. On a long-term average basis, the basin is likely in balance, and the adjustment is much smaller than the uncertainty in many of the water balance items.

8.2. PROJECT CONDITIONS

The Paraiso Springs Resort project would alter numerous aspects of the water balance. Impervious surfaces and irrigation would change the amount of rainfall recharge, irrigation return flow would become significant, consumptive use by irrigated vegetation and evaporation from water features would increase, as would groundwater pumping. Each of these changes is evaluated below for buildout conditions assuming 70-85-85 annual occupancy and compiled into the annual and monthly "Project" water balances (**Table 5**).

8.2.1. Inflows

Rainfall recharge would change as a result of land use conversion. Land cover in the development area would change as shown in **Table 6**. Undeveloped areas presently supporting trees, shrubs and grassland would decrease in area and be replaced by irrigated and impervious areas. Irrigation usually produces some deep percolation beneath the root zone due to non-uniformity of application and the need to ensure that the driest part of the vineyard or landscaping receives adequate water. Irrigation also alters rainfall recharge because the soil profile is moister at the start of the wet season than it would be under natural conditions. Thus, less rainfall infiltration is needed to fill the profile and initiate deep percolation. These processes are simulated concurrently and continuously in the soil-moisture-budget spreadsheet model, and simulated deep percolation includes irrigation return flow as well as rainfall recharge. Irrigation amounts for the three types of irrigated vegetation are estimated under "Outflows", below. The deep percolation of rainfall and applied irrigation water included 20 percent of turf irrigation (which is applied by sprinkler) and 5 percent of vineyard and drought-tolerant landscape irrigation (which is applied by drip). Total deep percolation in irrigated areas would average 22.7 AFY, of which 4.9 AFY would derive from applied irrigation water and 17.8 would derive from rainfall.

Table 6. Land Cover in Development Area under Existing and Project Conditions

Project Land Cover	Acres Converted From	
	Trees/shrubs	Grassland
Irrigated turf	0	8.5
Irrigated vineyard	0	6.8
Irrigated - general	3	5.5
Impervious	7.5	15.7
Trees/shrubs/grassland	7.6	0.3
Total	18.1	36.8

Runoff from impervious areas would increase groundwater recharge because the runoff would be routed to infiltration areas next to the impervious areas. These stormwater management features include bioswales and small retention basins, collectively referred to as "low-impact development" in modern stormwater guidelines (California Stormwater Quality Association, 2017). These features are expected to infiltrate runoff from 74 percent of the 23.2 acres of impervious area (CH2M HILL,2008b). The infiltration would be concentrated in relatively small areas and occur in winter when ET rates are low. Accordingly, all of the additional infiltration was assumed to become groundwater recharge. For average annual rainfall of 17 inches, groundwater recharge from impervious area runoff would be 24.7 AFY.

Inflows from stream percolation, hill slope recharge in the tributary watershed and hydrothermal groundwater inflow would not be altered by the project and would remain the same as under existing conditions.

Wastewater from the project would not be percolated into the basin. All of it would be recycled for irrigation use, with an underground reservoir providing seasonal storage.

8.2.2. Outflows

Groundwater would be pumped from the basin to supply Project needs for indoor use, water treatment and some of the irrigation. Groundwater would be produced from existing Wells #1 and #2. Although Well #2 is deep and screened below the alluvium, the water balance assumes that the deep pumping would induce downward leakage from the alluvial aquifer and accordingly is included in the alluvial water balance calculations. In terms of impact analysis, this represents a worst-case assumption that all pumping is from the alluvial aquifer. However, while it is worst case it is not likely.

Groundwater pumping for domestic use would equal 38.6 AFY at buildout with the 70-85-85 occupancy assumption (**Table 5**). Water pumped for domestic use would be treated to remove fluoride. The activated alumina treatment process would also use water. This consumptive use is 5 percent of the treated water (CH2M HILL, 2010a), which amounts to 1.9 AFY for this phase and occupancy level.

Recycled water generation is relatively constant throughout the year, whereas irrigation demand occurs almost entirely during the dry season. Recycled water generated during the wet season must be stored in order to use it for irrigation the following dry season. The Project plans to store the recycled water in anunderground reservoir. The required storage capacity depends on the project phase. The 70-85-85 occupancy assumption is appropriate for representing full occupancy during the October-March storage season. The required capacity would increase from 1.5 mgal in Phase 1 to 4.1 mgal at buildout.

Groundwater pumping for irrigation would also vary by project phase. The irrigatedareas in the landscape plan were assumed for all phases, but recycled water generation would increase from Phase 1 to buildout. In Phases 1-3 annual irrigation demand would exceed the annual recycled water supply, and the difference would be made up with groundwater. At buildout, the recycled water supply would slightly exceed the irrigation demand estimated for Phases 1-3, but a small, agronomically reasonable increase in application rate would consume the additional recycled water through increased ET (see Section 7 for additional discussion). Thus, groundwater pumping for irrigation would decrease from 15.9 AFY in Phase 1 to 0 AFY at buildout.

Evapotranspiration by each area of wetland and riparian vegetation was assumed to remain unchanged from the existing amounts. Evaporation from a proposed ornamental pond 0.3 acre in size plus several small recirculating water features was estimated by multiplying the water surface area by the difference between annual reference ET and annual rainfall, which was 38.7 in/yr. This assumes that the pan-to-lake coefficient is comparable in magnitude to the ratio of reference ET to pan evaporation. One small seasonal wetland would be removed during development, which would decrease total evapotranspiration for that vegetation category from 0.2 to 0.1 AFY.

Finally, groundwater outflow from Paraiso Springs Valley was adjusted so that total outflows equaled total inflows. This reflects the expected response of the groundwater system to the project, which is that any change in consumptive use of groundwater within the valley will be balanced over the long run by an opposite but equal change in groundwater outflow. Groundwater storage within the basin would equilibrate to the new stresses and not continue to increase or decrease over the long run. The resulting groundwater outflow estimate at average occupancy under buildout conditions (722.2 AFY) was 15.5 AFY smaller than under existing conditions. This is a decrease of 2.1 percent relative to existing conditions.

9. NITRATE BALANCE

Natural sources of nitrogen in groundwater are small, as reflected in the measured concentrations of 1.2 mg/L and non-detect in Well #1 and Well #2, respectively. Under Project conditions the membrane bioreactor wastewater treatment process would decrease the concentration of nitrate-nitrogen in recycled water to less than 10 mg/L (CH2M HILL, Inc., 2010b). Monterey County Code, Chapter 15.23 requires recycled water to have a nitrogen concentration no greater than 6 mg/L if the water will be percolated and become groundwater recharge. The Resort will use all of the wastewater produced by the treatment plant for irrigation, storing it seasonally in an underground reservoir. The membrane bioreactor wastewater treatment plant will reduce the nitrogen concentration in recycled water to 6 mg/L or less. The irrigation rates will be agronomically reasonable in terms of water volume (as described in previous sections) and also in terms of nitrogen load. All of the nitrogen in recycled water used for irrigation would be taken up by plants and would not pose a risk of groundwater contamination.

10. POTENTIAL HYDROLOGIC IMPACTS

Four potential impacts related to groundwater were identified and evaluated:

- Loss of yield at neighboring wells and springs
- Depletion of groundwater in the Salinas Valley
- Dewatering of wetland and riparian vegetation
- Increased groundwater salinity

The loss of yield at a neighboring well or spring due to groundwater pumping by Paraiso Springs Resort would not necessarily be considered a legal impact under California water law. However, for purposes of this hydrogeologic report, the legal consequence of production will be ignored and only the hydrologic impacts will be considered.

10.1. POTENTIAL IMPACT: LOSS OF YIELD AT NEIGHBORING WELLS AND SPRINGS

Groundwater pumping at the two Project supply wells would lower water levels in the vicinity of the wells. This drawdown decreases with distance but could extend down the valley beyond the eastern Project boundary, where there are at least five residences supplied by on-site domestic wells or springs within 0.7-1.2 miles of the Project supply wells.

Drawdown would significantly impact a neighboring well if it lowered the static water level below the top of the well screen. When water levels fall below the top of the well screen, the screen is exposed to air—which promotes corrosion—and water cascades into the well, entraining air which can cause pump damage due to cavitation. Drawdown would also significantly impact neighboring wells or springs if it decreased the well yield or spring discharge to the point that existing beneficial uses of the well or spring could no longer be supported.

If the Project and neighboring wells were located in the interior part of a large groundwater basin, the amount of drawdown could be estimated using analytical well functions. However, Paraiso Springs Valley is a narrow spur located at the edge of the Salinas Valley groundwater basin. The alluvial deposits become thicker and wider from west to east, and outcrops of the less permeable Tierra Redonda Formation obstruct the direct propagation of drawdown from the pumping wells to some of the receptor wells. Because of this complex geometry, a numerical groundwater flow model was used to estimate impacts.

Existing data were used to formulate the initial model input parameters. Some input parameters, including proposed well pumping rates, water use/return flow estimates, and aquifer hydraulic conductivity, were defined on the basis of site measurements or estimates and were not varied during the model simulations. Other parameters, including aquifer thickness and geometries within the valleys were estimated from borehole information and principles of depositional geologic processes. Boundary conditions were adjusted within defined ranges to achieve model calibration.

The model was constructed using the United States Geologic Survey (USGS) numerical finite-difference program MODFLOW. MODFLOW was selected for its ability to simulate the non-uniform geometry and limited extent of the alluvial aquifer in Paraiso Springs Valley. The one-layer model simulates groundwater flow within the alluvial aquifer.

Figure 6 shows the model area and boundaries. The model area includes the mapped extent of older alluvium and older fan gravels in Paraiso Springs Valley, alluvium in the adjacent Indian Valley, and in the Paloma Ridge Trail Valley area north of Paraiso. The model extends downgradient around one mile east of Paraiso Springs Valley to near the western edge of the Salinas Valley. Several known nearby private and agricultural wells are located in the model area.

The MODFLOW model simulates groundwater flow in a defined area and solves the governing equations controlling groundwater flow using the finite-difference method. For this numerical method, a rectangular grid of model cells is constructed, and hydraulic head is calculated at each grid cell. The model comprises a grid of 134 rows by 212 columns, with a uniform row and column grid spacing of 50 feet. A single MODFLOW layer represents the alluvial aquifer.

Model boundary conditions were defined based on inferred groundwater elevations and the estimated amount of natural recharge to the Terra Redonda sandstone and alluvial aquifer. Net groundwater recharge to the Paraiso Springs Valley from precipitation in the tributary watershed was estimated using the Darcy Equation to equal 730 AFY, which was comparable to estimates produced by another method (see Section 7.1.1 “Inflows”).

Model boundary conditions simulated this total amount of recharge (730 AFY), distributed as inflow along the alluvial valley aquifer boundaries. Lateral specified flux boundaries were defined along model boundary arcs across bordering Paraiso Springs Valley and along the valleys to the north. Constant head boundaries were also defined at the upgradient edges of the alluvial aquifer and the downgradient boundary near Salinas Valley. Natural recharge of precipitation on the valley floors also was simulated at a rate of 0.18 feet per year, as estimated using a soil moisture budget spreadsheet model (see Section 6 “Water Balance).

Other key model input parameters include the alluvial aquifer hydraulic properties: aquifer thickness, aquifer geometry, and hydraulic conductivity. Available geologic and groundwater level data were reviewed to characterize the aquifer conditions and define the alluvial aquifer geometry and hydraulic properties, including information from on-site wells and borings (**Figure 5**; **Tables 2** and **3**). The wells and borings are located in upgradient and downgradient portions of the Paraiso Springs Valley. The model grid was constructed using the MODFLOW Layer Property Flow (LPF) Package, with defined aquifer bottom elevations. The base of the model dips to the east from elevations of around 1,300 feet msl at the western limit of alluvial deposits along the base of the mountains to elevations of around 600 feet in the thickest portions of the alluvial basin, consistent with the estimated elevation of the base of the alluvium in Paraiso Springs Valley. A low bedrock ridge occurs between Paraiso Springs Valley and the smaller Indian Valley to the north. A bedrock ridge also occurs along the southwestern model boundary south of Paraiso Springs Valley.

A uniform hydraulic conductivity of 34 feet/day, the value derived from the 10-day pumping test of the Main Well (Well #1), was assigned to the alluvial aquifer.

The model was calibrated to inferred groundwater levels based on measured water levels in the 29 onsite borings drilled during 2004 and in the Main Well. The calibration process included trial-and-error adjustment of input parameters until simulated groundwater elevations matched observed levels. Once calibrated, water table drawdown was simulated using anticipated pumping rates of the production wells.

A contour map of simulated groundwater elevations under existing conditions is shown on **Figure 7**. The elevations are consistent with the hydrogeologic conceptual model. Groundwater inflow occurs via the western boundaries along the mountain fronts. Within the model area, the groundwater elevation contour patterns reflect the boundary conditions and recharge sources. Groundwater flow occurs from the western edges of the creek valleys to the east, into the Salinas Valley.

To assess model accuracy, simulated heads were compared with observed heads. The final calibrated model simulates flow conditions which are similar to the inferred groundwater elevations from the 2004 soil borings and Main Well, indicating that the model is sufficiently calibrated to serve as a tool for simulating drawdown that would result from Project pumping.

To determine the potential impacts of the proposed groundwater pumping on water levels at off-site neighboring wells, an additional MODFLOW simulation was made using the net increase in consumptive groundwater use of 15.5 AFY. This equals the net annual change in groundwater outflow under Buildout conditions with 70-85-85 occupancy. Note that changes in recharge occur between the Project supply wells and the downgradient edge of the resort property, and the combined effect of changes in pumping and recharge is reflected in the net annual outflow. The net consumptive use was implemented as one year of continuous pumping at the Main Well, and simulated groundwater elevations and drawdown were used to assess impacts of the pumping on downgradient areas.

Figure 8 shows the predicted water table drawdowns resulting from continuous pumping of the Main Well. The steady-state drawdown represents the maximum drawdown that would result after a year or more of Project operation at buildout with 70-85-85 occupancy. The maximum simulated drawdown at the neighboring wells was approximately 0.5 foot at the closest neighboring well (Gallo). Smaller drawdowns were estimated at more distant neighboring wells.

Impact Evaluation

Well logs are not available for the potentially impacted wells. However, the average depth to the top of the well screen for domestic wells in the Arroyo Seco fan area (Bulletin 118 basin 3-4.04) is 270 feet (Boyle and others, 2012). Well permit applications for four wells on the Pisoni and Pura Ranch properties near Paraiso Springs Resort proposed well depths of 200-800 feet (Ford, 2013). The water table is within a few feet of the land surface at the eastern Project boundary and is 40-60 feet below the ground surface at wells monitored by Monterey County Water Resources Agency 4 miles east of the Project site. Interpolating between those locations, it is very unlikely that the water table is anywhere close to the top of the well screen at the potentially impacted wells. Therefore, the 0.5 foot of drawdown caused by the project at the nearest neighboring well would not dewater the well screen, and potential impacts related to well screen dewatering are less than significant. Simulated drawdown at the Paraiso spring used by the Pura Ranch was approximately 0.8 foot which is very small. Springs are sometimes associated with local hydrogeologic anomalies. It is possible that even if drawdown occurred in the general vicinity of the spring, the spring discharge might not be affected.

Potential impacts on well yield are less than significant for similar reasons. If the pumping water level remains above the well screen—as would almost certainly be the case—any change in pumping rate due to drawdown would reflect the head-capacity curve of the well pump. For example, a domestic well pump designed to pump 15 gpm at 200 feet of total head loses only 0.27% of its pumping rate for every additional foot of pumping lift (Grundfos, Inc., 2014). Pumping cycles for domestic wells are typically brief and widely spaced. The pump runs only long enough to refill the pressure tank that supplies the house. A small decrease in pumping rate is automatically compensated for by a small increase in the duration of each pumping cycle. Therefore, there is no loss of supply to the well owner.

The flow from the spring on Paraiso Springs Resort property presently used by two residences on the nieghboring Pura Ranch property could descrease slightly. This would not have an environmental impact because the entire flow (approximately 1 gallon per minute) is already diverted at the spring box. Under California water law, spring water is considered surface water after it leaves the ground. However, the diversion to the neighboring parcel is not pursuant to a surface water right but rather to a contract between the two parcel owners that was initiated in 1918. Thus, any change in spring discharge would be governed by the terms of the contract.

The above water-level drawdown analysis is based on hydrologic conditions in an average year. The potential impact on off-site wells and springs during droughts can be estimated based on the expected decrease in groundwater recharge in those years. The primary source of groundwater recharge in Paraiso Springs Valley is inflow from bedrock in the tributary watershed area. Dry-season flow in Arroyo Seco is similarly supplied by groundwater draining from bedrock throughout the watershed. To evaluate the percentage by which this bedrock drainage decreases during droughts, total base flow during July through November was tabulated for the Arroyo Seco near Soledad gage for each year during 1987-1993. The minimum 2-year base flow volume occurred during 1991-1992 and equaled 15 percent of the long-term average base flow for those months. The 2-year minimum was selected because the storage capacity in Paraiso Springs Valley is sufficient to moderate the effect of a single extreme year. Average annual groundwater outflow from Paraiso Springs Valley after the resort is fully built out would be 722 AFY (**Table 5**). The 2-year minimum outflow during a prolonged drought is estimated to equal 15 percent of the average outflow, or 109 AFY. This is still many times greater than the combined domestic use of the three or four downgradient groundwater users, which is on the order of 2-5 AFY.

The effect on Salinas Valley groundwater levels and storage during droughts would be vanishingly small. If the 15.5 AFY of net consumptive use by the project were accumulated as a storage deficit for six consecutive years—which unrealistically assumes that recharge drops to zero throughout that period—it would translate to a water-level decline of 1.2 foot over the area included in the groundwater model (590 acres), or 0.02 foot over the Arroyo Seco Cone region (43,350 acres). Declines of these magnitudes would not impact well operation. Water levels at wells in the Arroyo Seco Cone area declined 15-30 feet during the 1987-1992 drought. The wells are typically several hundred feet deep and continued to function during that drought. An additional decline of 0.02 foot would not be noticeable and certainly not be a problem.

In summary, the Project would not significantly decrease the yield of nearby wells and springs. No mitigation is necessary.

10.2. POTENTIAL IMPACT: DEPLETION OF GROUNDWATER IN THE SALINAS VALLEY

The Project would decrease average annual groundwater inflow to the Salinas Valley by the amount of net consumptive water use for the Project, which would be 15.5 AFY at buildout with 70-85-85 annual average occupancy (see Section 6 “Water Balance”). Water resources in the Salinas Valley are actively managed to supply water for agriculture and to prevent further seawater intrusion at the northern end of the valley. Because of its unique climate and productive soils, the Salinas Valley is one of the most important vegetable-producing regions of the United States, with $6 billion per year of agricultural economic activity (Agricultural Commissioner’s Office, 2011).

The water-resources challenges in the valley are regional and local. The regional challenge is to supply enough irrigation water to support the large amount of irrigated cropland, which continues to expand in the southern part of the valley. This is accomplished primarily by operation of Nacimiento and San Antonio Reservoirs, located on major tributaries near the south end of the valley. Water released from the reservoirs percolates through the gravelly bed of the Salinas River along the 75-mile length of the valley, providing a critical source of groundwater recharge.

The local challenge is at the north end of the valley, where seawater has been intruding into the groundwater basin since the 1930s. Saline water has advanced up to 7 miles inland, rendering wells in the coastal region unusable for irrigation or potable supply. The rate of intrusion reflects the overall water balance of the Salinas Valley groundwater basin but is particularly sensitive to recharge, pumping and water levels close to the coast. In 2011, for example, groundwater elevations south of Salinas inland of the intrusion front were 22 feet below sea level in the 180-Foot aquifer and 30 feet below sea level in the underlying 400-Foot aquifer. Part of the management challenge stems from hydrogeologic conditions near the coast. Extensive clay confining layers limit the ability of Salinas River percolation or other sources of recharge at the ground surface to percolate down to the intruded water-supply aquifers and raise water levels. Consequently, reservoir releases alone have historically been unable to halt intrusion. The most effective measures have involved substituting recycled water and surface water for groundwater as the primary sources of irrigation supply.

From a water balance perspective, any large increase in consumptive use of groundwater anywhere in the Salinas Valley could theoretically exacerbate seawater intrusion. The increase would lower groundwater levels and thereby increase percolation from the Salinas River, decreasing the amount that reaches the Salinas River Diversion Facility near the coast, which supplies irrigation water to a coastal agricultural service area. As a practical matter, consumptive use of groundwater by the Paraiso Springs Resort Project would not increase seawater intrusion, because the impact on groundwater and water supply conditions near the coast would be extremely small and because agencies will continue to implement programs to counteract intrusion.

In the context of the overall water balance of the Salinas Valley groundwater basin and of Nacimiento and San Antonio Reservoirs, the 15.5 AFY of increased Salinas River percolation that might result from the Paraiso Springs Resort Project is extremely small. Recharge from rainfall, irrigation return flow and river recharge in the Salinas Valley averaged 452,000 AFY during 1970-1994 (Montgomery Watson, Inc., 1997). The amount of water released from Nacimiento and San Antonio reservoirs averaged 242,600 AFY during 1968-2013, which is the period following completion of the reservoirs (MCWRA, 2017).

Consumptive use of groundwater by the Project would theoretically lower groundwater levels over an expanding radius until the drawdown intersected the nearest head-dependent surface water body, which in this case is the Salinas River located 8 miles away to the east and north. If the 15.5 AFY of annual storage depletion were distributed uniformly over that area, it would lower water levels by about 0.02 inch. The drawdown would accumulate each year until it induced 15.5 AFY of additional seepage out of the river. Some of that seepage would occur during periods of natural runoff when the river is discharging to Monterey Bay. During those periods, the seepage would be capturing water that would otherwise flow to the Bay, and therefore would not impact existing developed water resources. At other times, the seepage would deplete flow derived from reservoir releases and thereby diminish the yield of the Salinas Valley Water Project. Regulated releases occur during seven months of the year, or 58 percent of the time. Therefore, a reasonable estimate is that the impact on managed water supplies would be 58 percent of 15.5 AFY, or 9.0 AFY. This impact is equivalent to 0.002 percent of average annual recharge to the Salinas Valley basin and 0.004 percent of average annual reservoir releases. This infinitesimal impact is less than significant from a practical standpoint.

The second reason that the Paraiso Springs Resort Project would not increase seawater intrusion is that intrusion is being actively managed by local agencies, and those agencies already expect consumptive use of groundwater in the Salinas Valley to increase by much larger amounts. Monterey County Water Resources Agency is at the forefront of efforts to manage seawater intrusion. The Agency expects consumptive use in the Salinas Valley to increase by 8,600 AFY between 1995 and 2030 (MCWRA, 2001; Franklin, 2014). Implicit in this projection is that additional measures will need to be implemented to prevent seawater intrusion.

The 2010 Monterey County General Plan similarly states that “there shall be a rebuttable presumption that a Long Term Sustainable Water Supply exists within Zone 2C”, which encompasses the Salinas Valley, including the Project site. Thus, local government agencies responsible for land and water use planning would not consider the Project’s small increment of consumptive use to be a significant adverse impact on their planning or operations.

The history of managing seawater intrusion in the Salinas Valley further confirms the ongoing commitment of local agencies to control the problem. From this perspective, seawater intrusion appears not as a battle to be won but an issue to be monitored and managed as evolving circumstances warrant. Seawater intrusion was first detected in 1938, but in spite of its steady advance over the subsequent 75 years no coastal cropland has gone out of production. Landowners and local water agencies have consistently responded to the problem with a series of measures designed to reduce or work around seawater intrusion:

- Constructing Nacimiento and San Antonio reservoirs to augment groundwater recharge in the Salinas Valley, which helps elevate groundwater levels and repel seawater intrusion
- Drilling deeper wells in the coastal area—first to the 400-Foot aquifer and then to the Deep aquifer
- Constructing the Regional Wastewater Treatment Plant to deliver recycled water to coastal cropland in lieu of pumping groundwater
- Constructing the Salinas Valley Water Project to deliver surface water to coastal cropland in lieu of pumping groundwater

Other measures and projects are possible, and past experience suggests that funding and political will would be marshalled to implement them rather than allow cropland to go out of production.

These historical and institutional perspectives on intrusion support the interpretation that the *de minimus* impact of the Project on Salinas Valley groundwater supplies is in fact less than significant.

10.3. POTENTIAL IMPACT: DEWATERING OF WETLAND AND RIPARIAN VEGETATION

The two wells that would supply water for the Project are located at the western end of Paraiso Springs Valley. Water-level drawdown would be greatest near the wells, but the water table at that end of the valley is sufficiently far below the ground surface and creek channel that wetland and riparian vegetation are not present. Offsetting changes in rainfall recharge, irrigation return flow and recycled water percolation would occur between the wells and the eastern end of the valley where wetland and riparian vegetation are present. Thus, drawdown in those areas would correspond to the net increase in groundwater consumptive use rather than the instantaneous well pumping rate.

The change in water table elevation in the groundwater-dependent habitat areas can be estimated by the change in water-level gradient that would be associated with the decrease in groundwater outflow from the valley. The 15.5 AFY decrease in outflow equals 2.1 percent of existing outflow. A 2.1-percent decrease in the water table gradient would result from a lowering of water levels by about 3.0 feet near the Project wells, decreasing to 0 feet at the eastern end of the valley. By interpolation, groundwater elevations would decrease by an average of 1.5 foot or less at the wetland and riparian habitat areas.

It is unlikely that the amount and quality of wetland and riparian habitat would be substantially diminished by the Project, but monitoring and contingent mitigation are appropriate safeguards. These are described in Section 11 “Mitigation Measures”.

10.4. POTENTIAL IMPACT: INCREASED GROUNDWATER SALINITY

The Project would introduce salt and nitrate loads into the groundwater system. Nitrate loading is discussed in Section 8 “Nitrate Balance” and would result in less than significant impacts. Salt loads would derive from indoor use, evaporative concentration of applied irrigation water and net evaporation from the ornamental pond, as follows:

- **Indoor Use**. Normal indoor use for residential and commercial purposes typically adds about 250 mg/L of TDS to water (Pettygrove and Asano, 1985). The proposed wastewater treatment method would not remove the salt added during normal use. This salt load would increase the TDS of recycled water from 880 to 1,130 mg/L.
- **Evaporative Concentration of Irrigation Water**. When water is used for irrigation, a new salt load to the basin is created by evaporative concentration of the applied water. Plant ET removes pure H_2O from applied irrigation water, leaving the mineral content of the water behind in the soil. Subsequent rains and irrigation return flow flush those residual salts from the root zone down to the water table. The salt load equals the TDS content of the water consumptively used by the plants. At buildout, the total irrigation demand with average occupancy would be met by 36.7 AFY of

recycled water(**Table 4**). The concentration of applied irrigation water would equal the concentration of recycled water, or 1,130 mg/L. The weighted-average irrigation efficiency of the turf (80 percent) and vineyard and general landscaping (95 percent) is 85 percent. The annual salt load equals the annual irrigation application multiplied by the average TDS and the average consumptive fraction: 36.7 x 1,130 x 0.85 x 0.00136 = 47.9 tons per year, where 0.00136 is the multiplier to convert mg/L-AF to tons.

- **Evaporation from the Ornamental Pond**. If the pond is excavated below the water table, evaporative concentration of pond water will add salts to groundwater downgradient of the pond. Assuming a net evaporation of 1.0 AFY (see Section 6 "Water Balance") and initial pond TDS equal to average groundwater TDS (880 mg/L), the salt added to the pond water through evaporative concentration would equal 1.2 tons per year.

The total salt load would be the sum of these components, or 49.1 tons per year. Dividing this into the 797 AFY of total inflow to the basin under buildout produces an average increase in groundwater TDS of 45 mg/L. This would increase average groundwater TDS from 880 mg/L to 925 mg/L.

The increase in groundwater salinity is considered less than significant for three reasons. First, groundwater would still meet the upper SMCL for drinking water and would still be usable for irrigating all but the most salt-sensitive crops. Second, evaporative concentration of applied irrigation water is a normal and unavoidable consequence of irrigation. The Project is located in the Salinas Valley, where on the order of 500,000 AFY of irrigation water are applied every year with no regulation or control of evaporative salt loading. It would be unreasonable to consider the 37 AFY of Project irrigation significant while treating the much larger impacts of the surrounding agricultural industry as less than significant. Third, the Project design includes state-of-the-art stormwater infiltration facilities that will mitigate the salt loading by diluting it with rainwater. Low-impact design (LID) methods that will be used to maximize stormwater infiltration include site design and grading, porous paving, vegetated swales and buffer strips, and bioretention areas. These are expected to infiltrate almost all runoff from 74 percent of the impervious area (CH2M HILL, 2008b), which will reduce the average groundwater TDS to something less than 927 mg/L.

Salinity could potentially also increase at the spring used by the Pura Ranch by 45 mg/L. This impact is less than significant because potable use of the spring water already requires treatment and because the spring water TDS would still be within the acceptable range for livestock watering. A sample of spring water collected in June 2016 did not meet primary drinking water standards for bacteria or fluoride, or secondary drinking water standards for sulfate and total dissolved solids. A small increase in salinity could slightly increase the operating costs of a water treatment device (such as a reverse-osmosis unit) that the residents would have to install anyway to obtain potable water, and it could require a slight increase in applied irrigation water to landscape vegetation to maintain soil salinity within the tolerance range of the vegetation. These types of small mutual impacts between groundwater users are routine in groundwater basins and are not considered significant.

TDS concentrations of 1,000-3,000 mg/L are satisfactory for all classes of livestock (Bouder, 1998). The maximum salinity impact from the project would be near the bottom end of this range, and the impact would thus be less than significant.

One additional source of salinity was not included in the above tabulation because it might not occur. The hardness of the groundwater supply is 110-130 mg/L as $CaCO_3$, which is considered “moderately hard” to “hard”. If the Project includes self-regenerating water softeners, wastewater salinity could increase by 200 mg/L or more (AWWA, 2006). Given that ambient groundwater salinity is fairly close to the upper SMCL for drinking water and that alternatives to self-regenerating water softeners are available, this impact is considered significant and should be avoided. A recommendation for preventing water softener salt load is included in Section 11 “Mitigation Measures”.

11. MITIGATION MEASURES

Based on the foregoing impact analysis, the following monitoring and mitigation measures are recommended:

11.1. MONITORING AND MITIGATION MEASURE 1 FOR POTENTIAL IMPACTS TO WETLANDS

Monitoring of wetlands should include two components: visual inspection and monitoring of water table depth. The purpose of visual inspection is to assess the extent and health of the vegetation. Wetland vegetation could become stressed due to factors unrelated to groundwater levels, and conversely, groundwater levels could decline to some extent without noticeably affecting vegetation health. To help resolve questions of cause and effect related to the wetland areas, vegetation status should be monitored. Monitoring should consist of bimonthly visual inspection for abnormal amounts of leaf and branch die-back during the dry season (April-October). Observations should be made around the perimeter of wetland/riparian areas W4 and W5, where stress would likely appear first. Surveys may be conducted by resort personnel. Photographs should be taken at four or more designated photo stations. If signs of stress increase, the information should be forwarded to a qualified professional vegetation ecologist for additional evaluation and possible on-site surveys.

The purpose of monitoring the depth of the water table at the wetland areas is to determine whether any observed changes in vegetation health can be attributed to water-table decline. Shallow piezometers should be installed at the upgradient edges of wetlands W4, W5 and W6 mapped on Figure 3 of the 2016 updated wetlands report (WRA Environmental Consultants, 2016). These are the perennial wetlands closest to and therefore most likely to be impacted by pumping at Wells 1 and 2 or by salinity impacts of irrigation. Perennial wetlands and riparian vegetation occur only where the water table is shallow (less than 6 feet below ground surface). Therefore, piezometers for measuring groundwater level and quality at the water table can be easily installed by hand. PVC casing 1-2 inches in diameter would be appropriate.

One or two piezometers should be installed in a “control” area that would be similarly affected by droughts and other natural variables but not by well pumping or irrigation return flow. The small side valley in the northern part of the resort property (Indian Valley) might be an appropriate control location.

Depth to water below ground surface should be monitored at least quarterly (preferably monthly) for 10 years, starting before the resort development opens for occupancy. After 10 years, the monitoring data should be evaluated for trends and variability. If groundwater conditions are well-defined and stable, monitoring frequency can be reduced to semiannual.

A change in water level at the piezomenters can be attributed to project operation if water levels decline at the wetland sites and 1) decline less or not at all at the control sites and 2) decrease in magnitude with increased distance from the production wells.

If observable vegetation stress coincides with declining water levels or increased salinity, supplemental water should be supplied to the affected areas by irrigation or replenishment of open water areas, whichever is appropriate. The source of the supplemental water will be the project supply wells (Wells #1 and #2). It is unlikely that the full consumptive water use requirements of the vegetation would need to be replaced, but using that as a worst-case scenario, the water requirement for the non-seasonal wetland/riparian vegetation would be 2.3 AFY (**Table 6**). This would increase the annual project consumptive use from 15.5 to 17.8 AFY. The total use would still represent less than 2 percent of total basin inflow. The 2.3 AFY of additional pumping requirement would lower the water table by only 0.2 foot over the alluvial basin area. Thus, the groundwater supply and storage are more than large enough to support the additional demand even during a series of dry years.

During the month of peak groundwater use (June during Phase 1), the maximum plausible supplemental water demand for wetland/riparian consumptive use would be about 0.44 acre-foot, which equates to a continuous rate of 3.3 gpm. This would increase peak groundwater pumping to 50.3 gpm on a continuous basis, or 26 percent of the combined pumping yields of Wells #1 and #2. The total demand would slightly exceed the credited pumping yield of Well #1 but not the more appropriate alluvial-well yield credit of 58 gpm.

11.2. MONITORING AND MITIGATION MEASURE 2 FOR IMPACTS TO GROUNDWATER QUALITY

Water use at the resort would include irrigation of 23.8 acres of vegetation upgradient of wetland areas W1,W2 and W4 through W8. Irrigation increases groundwater salinity when evaporatively-concentrated minerals in the irrigation water are leached to the water table by winter rains. Furthermore, 44-100 percent of the irrigation will be with recycled water, which will have a higher total dissolved solids (TDS) concentration than ambient groundwater. The salt load from deep percolation of irrigation water would likely remain in the upper part of the alluvial aquifer over the relatively short distance from the irrigated area to the wetlands. The net effect of loading and mixing on the salinity of groundwater arriving at the root zone of wetland and riparian vegetation is difficult to predict quantitatively. Accordingly, electrical conductivity should be monitored in the shallow piezometers near wetland areas W4, W5 and W6 on the same schedule as the water-level measurements. If electrical conductivity increases by a statistically significant amount and vegetation begins showing signs of salinity stress, supplemental water should be applied to dilute root zone water salinity.

12. CONCLUSIONS

Key conclusions related to Project impacts and concerns raised in comments on the previously circulated DEIR include the following:

- The groundwater basin beneath Paraiso Springs Valley consists of mostly sandy unconsolidated alluvial deposits approximately 100 ft thick along the centerline of the valley. The alluvial groundwater basin is bounded on the sides and bottom by the older, more consolidated and less permeable Tierra Redonda Formation. Although this underlying unit does yield water to wells, most of the groundwater flow moving from the Sierra de Salinas mountains to the Salinas Valley moves through the alluvium.
- The water balance of the alluvial groundwater basin is dominated by groundwater inflow and groundwater outflow. Over 89 percent of inflow is from rainfall recharge on the 1.6-square-mile watershed tributary to Paraiso Springs Valley. The rainfall recharge enters the basin primarily as subsurface flow rather than as base flow in streams because the permeability of the alluvium associated with the tributary streams is fairly high.
- Two independent methods produced estimates of average annual groundwater inflow in the range of 700-750 AFY. These were a hydraulic calculation of groundwater flow down Paraiso Springs Valley using the Darcy Equation, and a daily soil-moisture-budget model applied to the tributary watershed.
- Existing consumptive use of groundwater in the valley is negligible. There is no irrigation, and the small amount of indoor water use at the two residences is almost entirely returned to the groundwater basin via a septic system.
- Estimates of indoor water demand for the Project presented in the DEIR used standard water use factors obtained from local water management agencies. The groundwater demand at buildout with an average long-term occupancy (70-85-85 percent occupancy) was 40.5 AFY, of which 38.6 AFY was for potable supplyand 1.9 AFY was consumed during water treatment.
- The two existing on-site wells have a County-approved long-term capacity rating four times greater than peak project water demand. Therefore, the wells are sufficiently reliable to meet the Project's supply needs.
- Irrigation water use by the project was also estimated using the soil-moisture-budget model and totaled 34.2 AFY during Phases 1-3 for 8.5 acres of turf, 6.8 acres of vineyard, and 8.5 acres of drought-tolerant landscape vegetation. At buildout, irrigation applications would increase slightly to fully consume the annual supply of recycled water (to 36.7 AFY with 70-85-85 occupancy). These irrigation estimates are smaller than the irrigation demand presented in the DEIR (57 AFY) partly because the previous estimate assumed an annual rainfall of only 11 inches and assumed a lower irrigation efficiency for the vineyard and drought-tolerant vegetation areas. As the Project approaches buildout, all irrigation demand would be met with recycled water. The net consumptive-use impact on the groundwater balance is the same whether irrigation is by groundwater or recycled water, because the latter derives from the Project supply wells

- The net consumptive use of water by the project is much smaller than the gross water use because of changes in rainfall recharge, irrigation return flow and recycled water percolation.
- Detailed water balances for existing and Project conditions at buildout with average (70-85-85 percent) occupancy showed that the increase in groundwater pumping would be offset by about 20.4 AFY of additional rainfall recharge (from percolation of impervious area runoff via LID measures and from increased rainfall recharge in areas that are irrigated) and 5.6 AFY of irrigation return flow. The net consumptive use of groundwater by the Project would be approximately 15.5 AFY, which would manifest as a decrease in long-term average groundwater outflow from Paraiso Springs Valley.
- The Project's consumptive use of groundwater equals only 2.1 percent of the average annual groundwater outflow from the Paraiso Springs Valley alluvial groundwater basin under buildout conditions. Even during droughts, groundwater would be more than sufficiently reliable to meet Project needs.
- A groundwater flow model was developed to simulate Project pumping impacts on water levels and yield at four wells and springs on neighboring parcels. A transient 1-year simulation of the net Project pumping stress indicated a drawdown of 0.50 ft at the closest neighboring well. Based on typical domestic well depths and screened intervals, this amount of drawdown would have a less than significant impact on well yield.
- Water table drawdown could conceivably diminish the extent or vigor of existing wetlands on the Project site. Monitoring of wetland area and health is recommended, with provision of supplemental water if Project-related impacts are detected.
- Net consumptive use of water by the Project would decrease groundwater flow from Paraiso Springs Valley to the rest of the Salinas Valley groundwater basin by 15.5 AFY. About half of that would be replaced by increased percolation of natural runoff in the Salinas River, leaving a net reduction of 9.0 AFY (0.002 percent) in average annual groundwater recharge in the Salinas Valley. This impact is considered less than significant because it comprises a tiny increment of regional increases in consumptive use that local agencies have managed in the past and are expecting to occur in the future.
- Ambient groundwater salinity is moderately high, and salt loads associated with the Project (salt pick-up during normal domestic and commercial use, evaporative concentration of irrigation water, and net evaporation from the ornamental pond) would bring it even close to the upper SMCL for drinking water. The Project will minimize the impact of the salt loads by maximizing on-site infiltration of storm water. It is further recommended that the Project not use self-regenerating water softeners.
- Nitrate loading to groundwater would not be significant because all recycled water would be used for irrigation at agronomic rates and the nitrogen content of recycled water would be low enough that the irrigated vegetation would take up all of remaining nitrogen.

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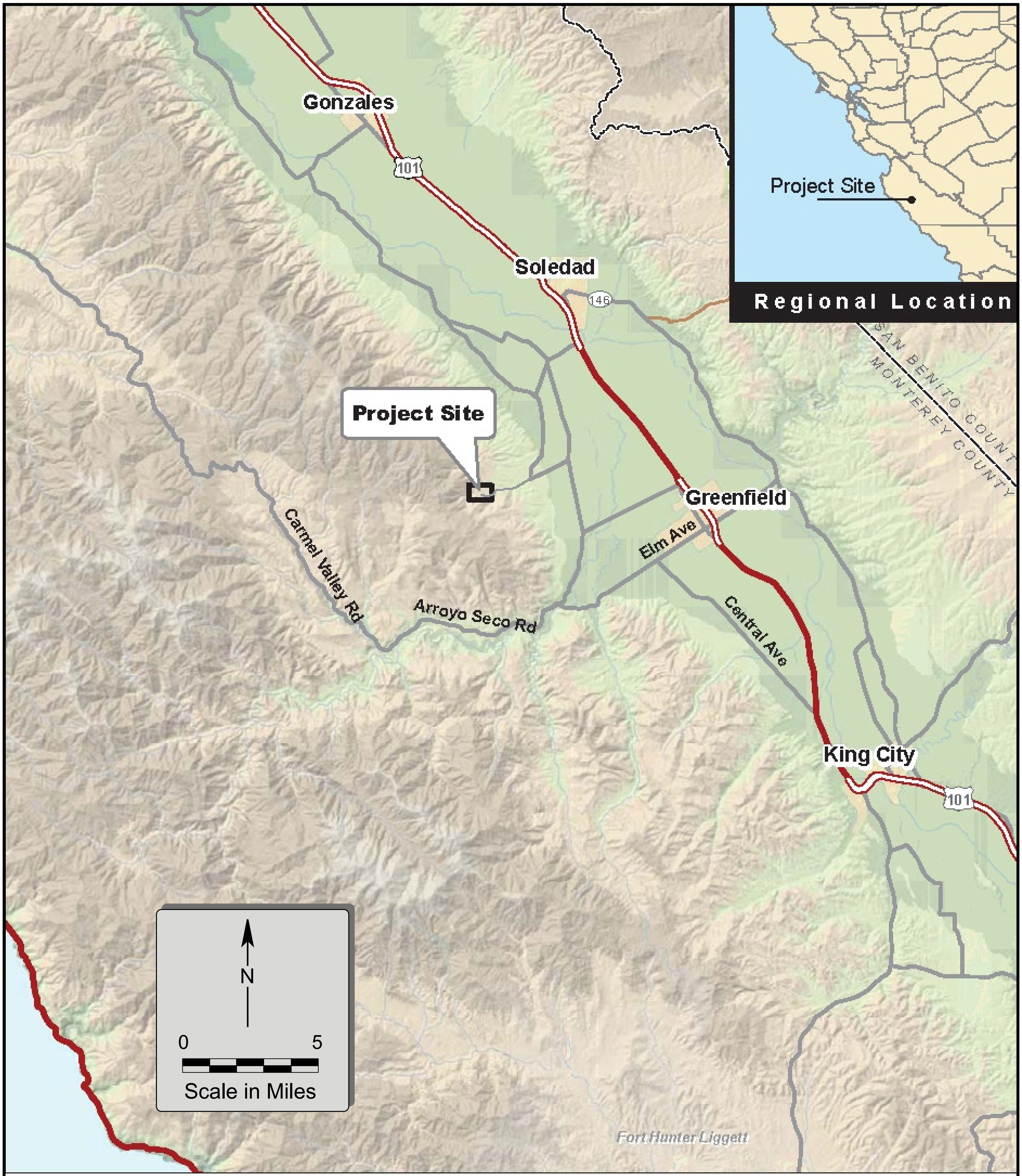

Source: RBF Consulting, 2010

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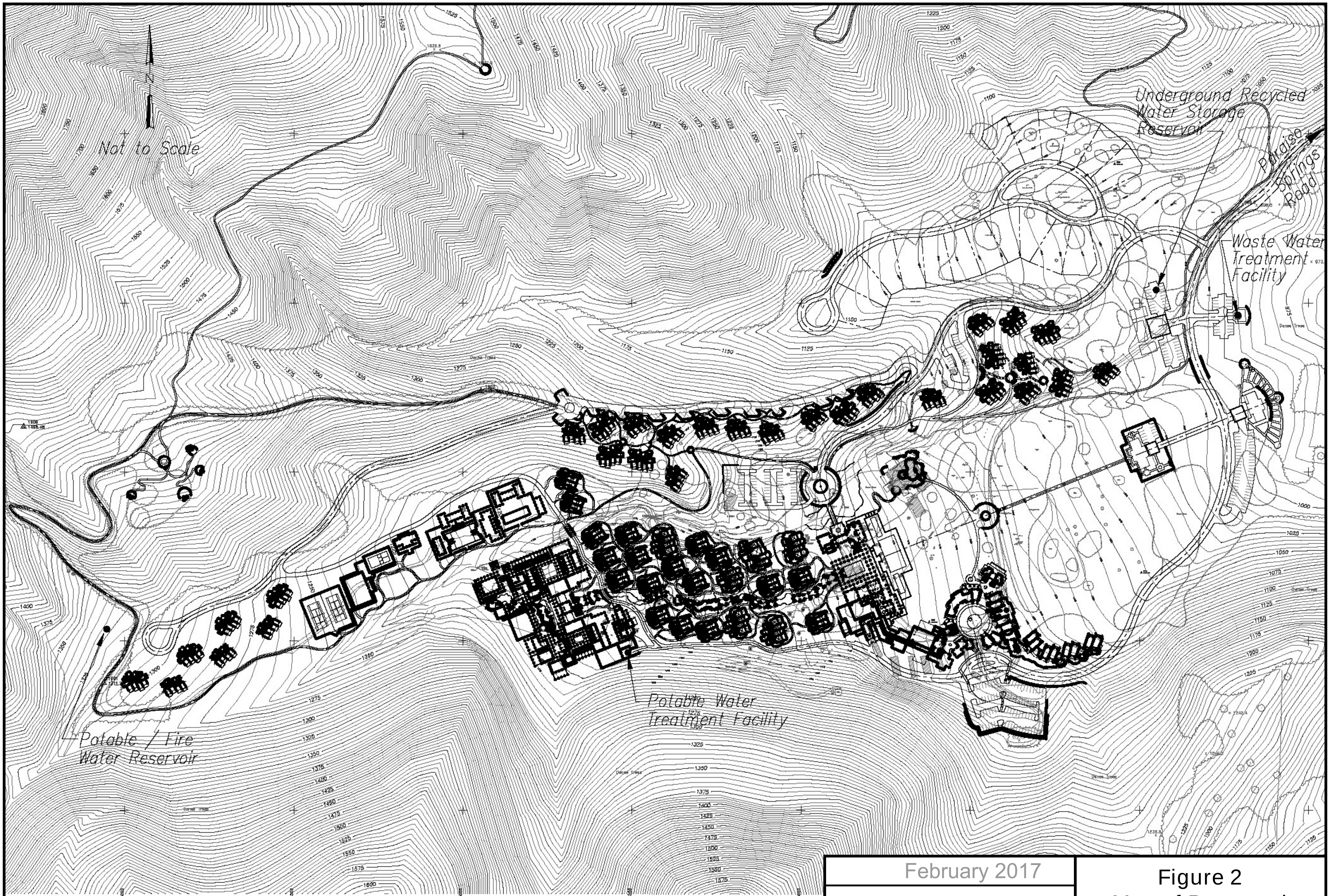
TODD GROUNDWATER

Figure 1
Project Location
Paraiso Springs



Source: CH2M , 2010b

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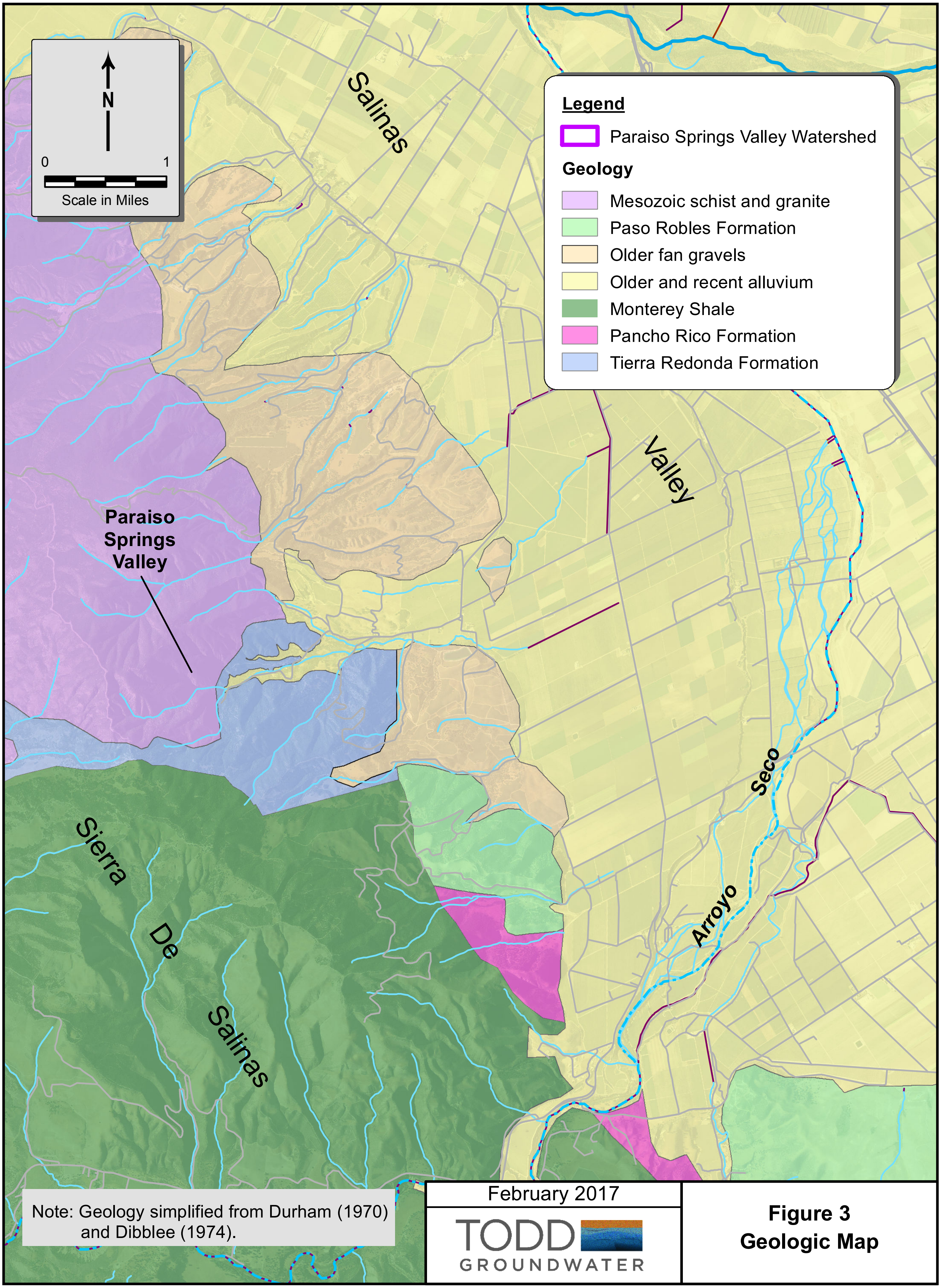
Figure 2
Map of Proposed Project Facilities
Paraiso Springs



Note: Geology simplified from Durham (1970) and Dibblee (1974).

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Figure 3
Geologic Map

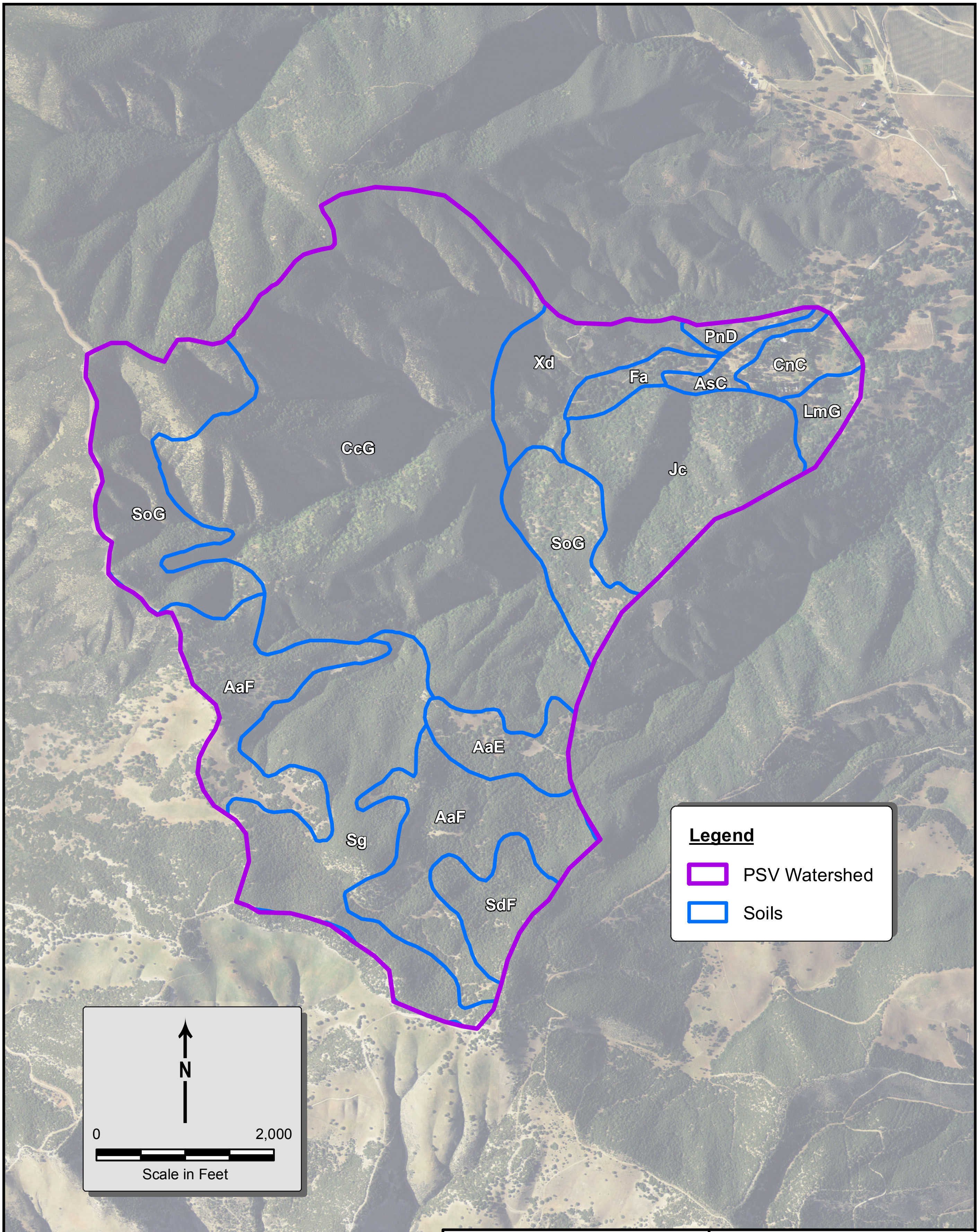

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Figure 4
Soils Map of Paraiso Springs Valley Watershed

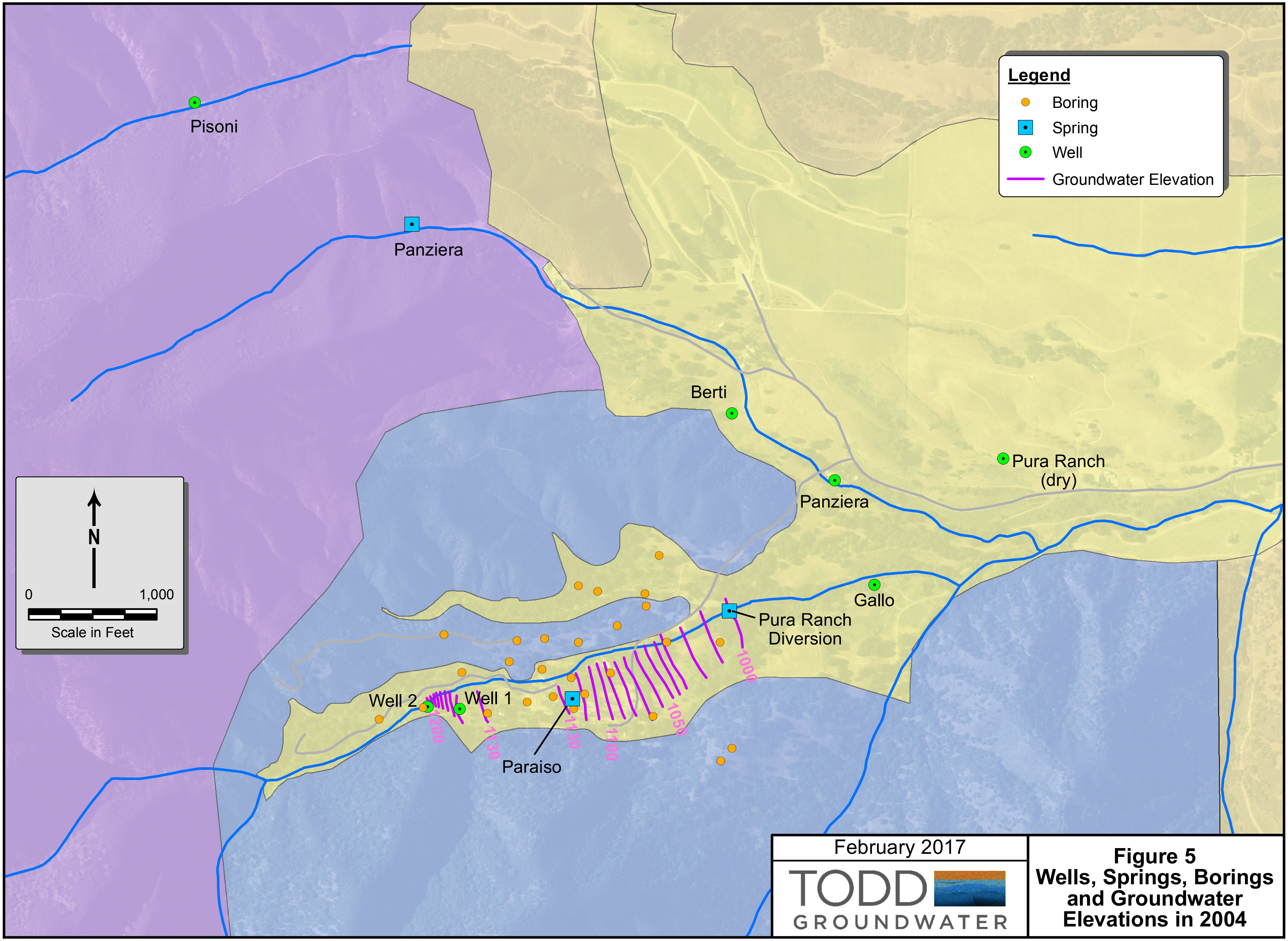

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Figure 5
Wells, Springs, Borings and Groundwater Elevations in 2004

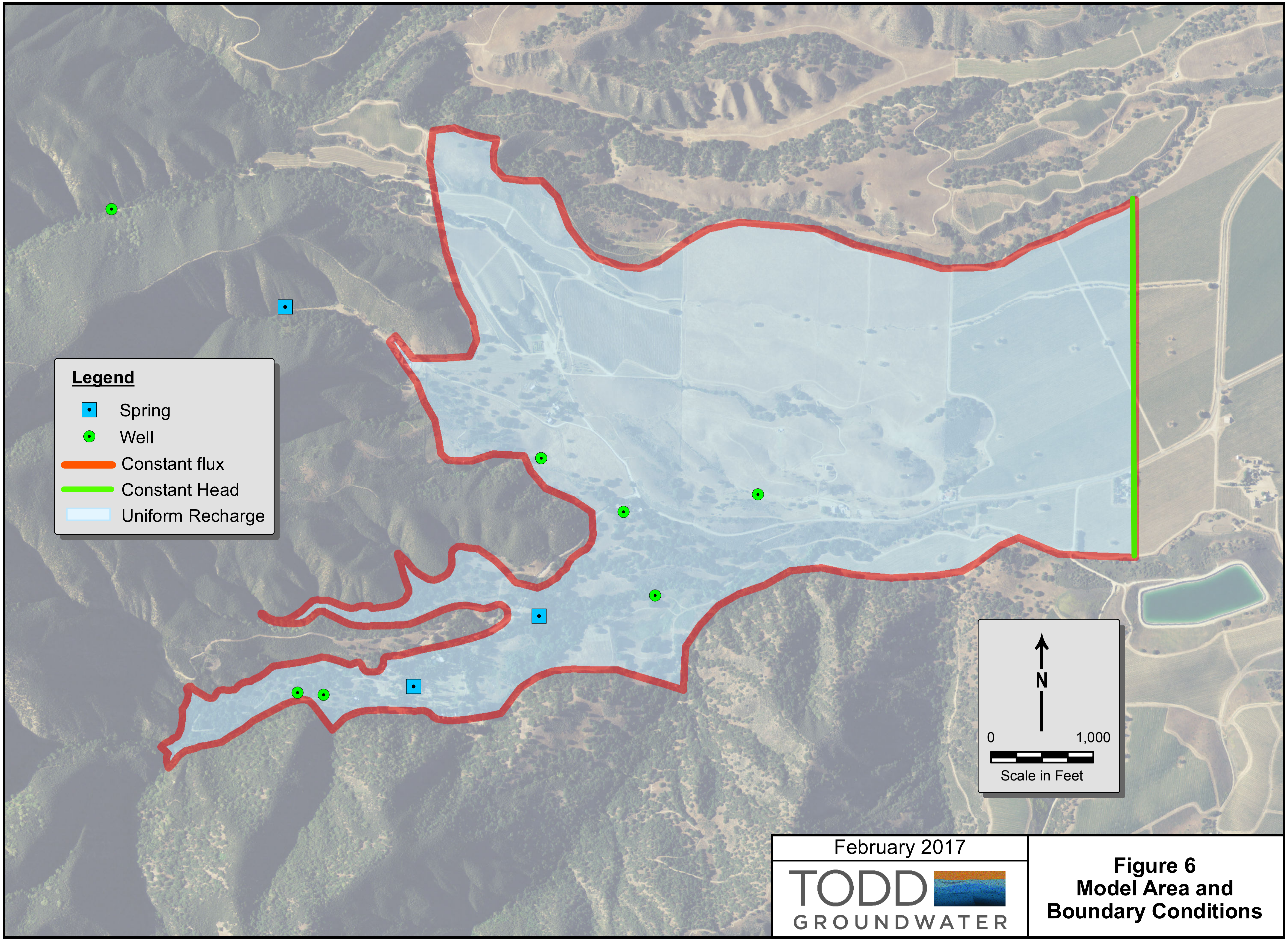

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Figure 6
Model Area and Boundary Conditions

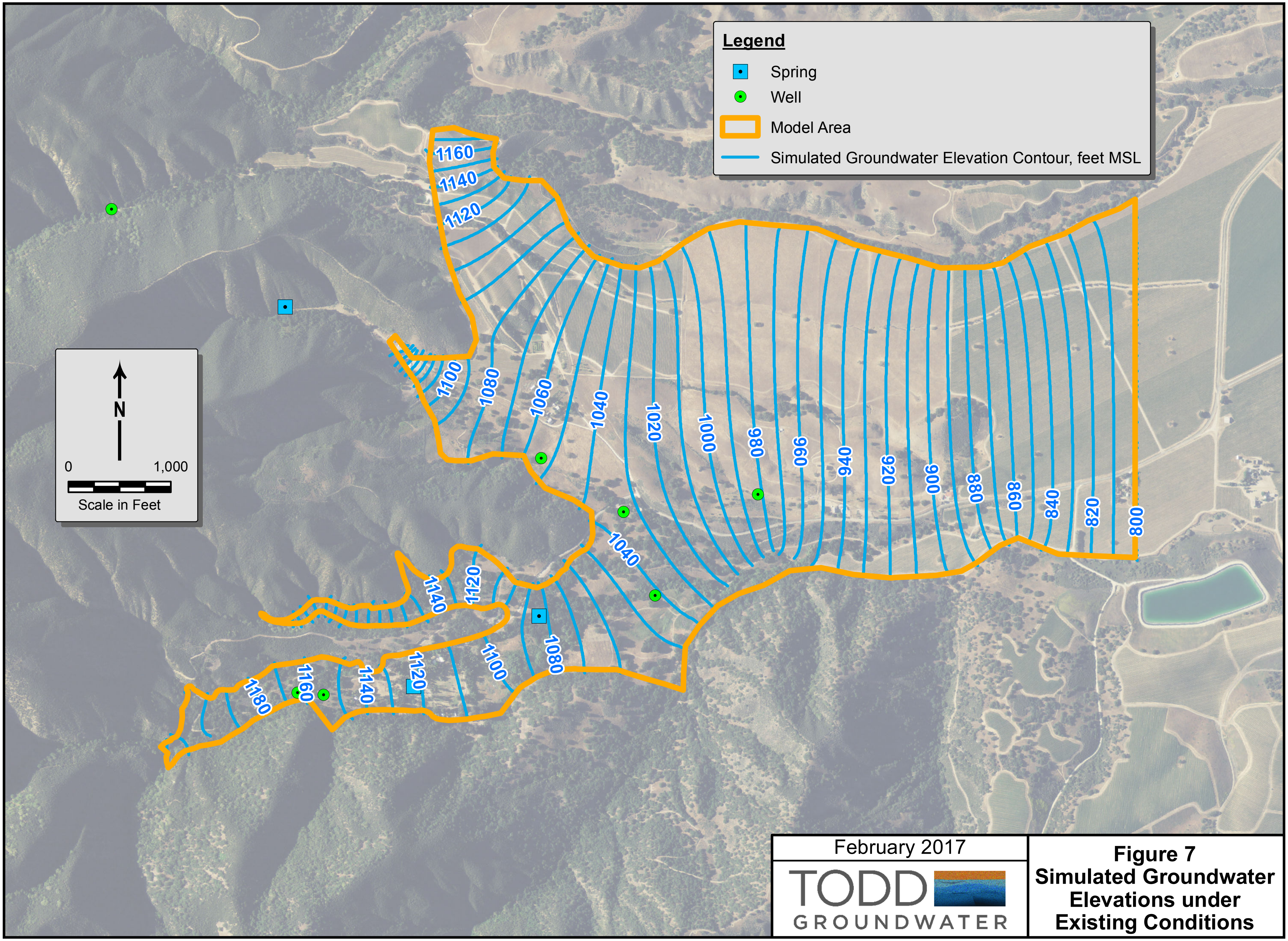

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Figure 7
Simulated Groundwater Elevations under Existing Conditions

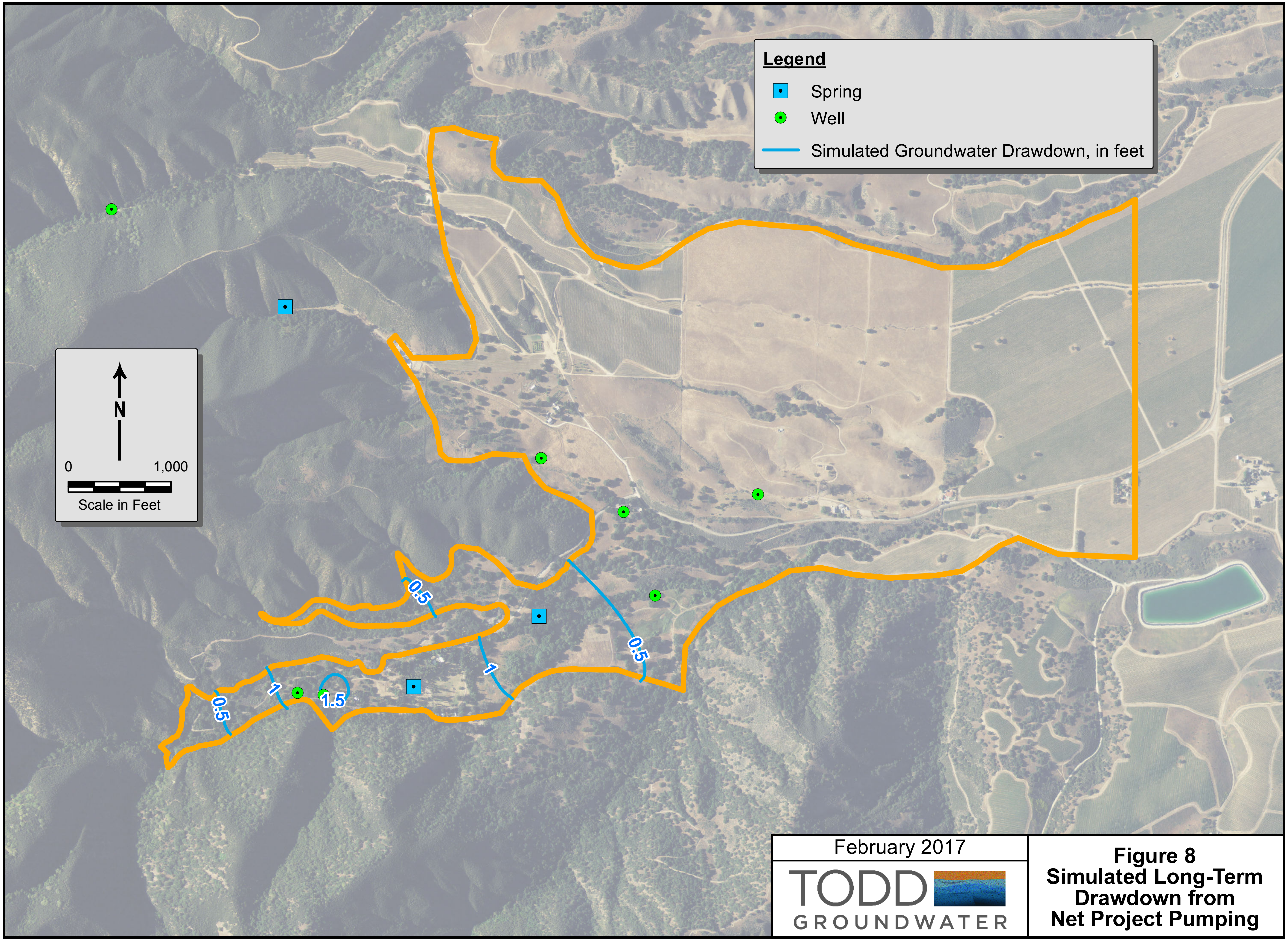

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Figure 8
Simulated Long-Term Drawdown from Net Project Pumping

Appendix A. Water Budget Tables

.

Table A-1. Monthly Recycled Water and Irrigation Operations: Phase 1, 70-85-85 Occupancy

	Assumed	Volumes in Acre-Feet												
Flow or Storage	Occupancy	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Irrigation Demand														
Turf		0.3	0.3	1.2	2.3	3.2	3.6	3.6	3.4	2.4	1.7	0.6	0.1	22.7
Vineyard		0.0	0.0	0.7	2.0	0.3	0.7	1.0	0.3	0.7	0.0	0.0	0.0	5.6
General landscaping		0.0	0.0	0.0	0.1	0.6	1.6	1.2	1.3	0.6	0.4	0.1	0.0	5.8
Total		0.3	0.3	1.9	4.3	4.0	6.0	5.8	5.0	3.7	2.1	0.8	0.1	34.2
Recycled Water Supply														
Hotel	70%	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	5.1
Condos and villas	85%	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	5.2
All other facilities	85%	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	7.0
Water treatment backflush		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0
Total		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	18.2
Wastewater and Irrigation Operation with Reservoir Storage														
Recycled water to irrigation		0.3	0.3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.8	0.1	13.6
Recycled water to storage		1.3	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.4	4.6
Irrigation from storage		0.0	0.0	0.4	2.8	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7
Recycled water percolation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycled water in storage		3.5	4.7	4.3	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.2	--
Groundwater to irrigation		0.0	0.0	0.0	0.0	1.0	4.4	4.2	3.5	2.2	0.5	0.0	0.0	15.9

Notes:

Potable water use (acre-feet per year):	19.2
Recycled water storage capacity (Mgal):	1.5

Table A-2. Monthly Recycled Water and Irrigation Operations: Phase 1, 85-100-100 Occupancy

Flow or Storage	Assumed Occupancy	Volumes in Acre-Feet												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Irrigation Demand														
Turf		0.3	0.3	1.2	2.3	3.2	3.6	3.6	3.4	2.4	1.7	0.6	0.1	22.7
Vineyard		0.0	0.0	0.7	2.0	0.3	0.7	1.0	0.3	0.7	0.0	0.0	0.0	5.6
General landscaping		0.0	0.0	0.0	0.1	0.6	1.6	1.2	1.3	0.6	0.4	0.1	0.0	5.8
Total		0.3	0.3	1.9	4.3	4.0	6.0	5.8	5.0	3.7	2.1	0.8	0.1	34.2
Recycled Water Supply														
Hotel	85%	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	6.2
Condos and villas	100%	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	6.1
All other facilities	100%	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.2
Water treatment backflush		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.1
Total		1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	21.7
Wastewater and Irrigation Operation with Reservoir Storage														
Recycled water to irrigation		0.3	0.3	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	0.8	0.1	15.9
Recycled water to storage		1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.7	5.8
Irrigation from storage		0.0	0.0	0.1	2.5	2.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8
Recycled water percolation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycled water in storage		4.3	5.8	5.8	3.2	1.0	0.0	0.0	0.0	0.0	0.0	1.1	2.8	--
Groundwater to irrigation		0.0	0.0	0.0	0.0	0.0	3.2	4.0	3.2	1.9	0.2	0.0	0.0	12.4

Notes:

Potable water use (acre-feet per year):	22.8
Recycled water storage capacity (Mgal):	1.9

Table A-3. Monthly Recycled Water and Irrigation Operations: Buildout, 70-85-85 Occupancy

Flow or Storage	Assumed Occupancy	Volumes in Acre-Feet												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Irrigation Demand														
Turf		0.3	0.4	1.3	2.5	3.5	4.0	4.0	3.8	2.7	1.9	0.7	0.1	25.2
Vineyard		0.0	0.0	0.7	2.0	0.3	0.7	1.0	0.3	0.7	0.0	0.0	0.0	5.6
General landscaping		0.0	0.0	0.0	0.1	0.6	1.6	1.2	1.3	0.6	0.4	0.1	0.0	5.8
Total		0.3	0.4	2.0	4.6	4.4	6.4	6.2	5.4	3.9	2.2	0.8	0.1	36.7
Recycled Water Supply														
Hotel	70%	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.6
Condos and villas	85%	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	17.7
All other facilities	85%	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	8.4
Water treatment backflush		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.9
Total		3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	36.7
Wastewater and Irrigation Operation with Reservoir Storage														
Recycled water to irrigation		0.3	0.4	2.0	3.1	3.1	3.1	3.1	3.1	3.1	2.2	0.8	0.1	24.2
Recycled water to storage		2.8	2.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.2	2.9	12.5
Irrigation from storage		0.0	0.0	0.0	1.5	1.3	3.3	3.1	2.3	0.9	0.0	0.0	0.0	12.5
Recycled water percolation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycled water in storage		8.8	11.5	12.5	11.0	9.6	6.3	3.2	0.9	0.0	0.8	3.0	6.0	--
Groundwater to irrigation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

Potable water use (acre-feet per year): 38.6

Recycled water storage capacity (Mgal): 4.1

Table A-4. Monthly Recycled Water and Irrigation Operations: Buildout, 85-100-100 Occupancy

Flow or Storage	Assumed Occupancy	Volumes in Acre-Feet												
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Irrigation Demand														
Turf		0.4	0.4	1.7	3.2	4.5	5.1	5.1	4.9	3.4	2.4	0.9	0.1	32.1
Vineyard		0.0	0.0	0.7	2.0	0.3	0.7	1.0	0.3	0.7	0.0	0.0	0.0	5.6
General landscaping		0.0	0.0	0.0	0.1	0.6	1.6	1.2	1.3	0.6	0.4	0.1	0.0	5.8
Total		0.4	0.4	2.4	5.3	5.3	7.5	7.3	6.4	4.7	2.8	1.0	0.1	43.5
Recycled Water Supply														
Hotel	85%	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	10.4
Condos and villas	100%	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	20.8
All other facilities	100%	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	9.9
Water treatment backflush		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.3
Total		3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	43.5
Wastewater and Irrigation Operation with Reservoir Storage														
Recycled water to irrigation		0.4	0.4	2.4	3.6	3.6	3.6	3.6	3.6	3.6	2.8	1.0	0.1	28.8
Recycled water to storage		3.3	3.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.6	3.5	14.6
Irrigation from storage		0.0	0.0	0.0	1.7	1.7	3.8	3.6	2.8	1.0	0.0	0.0	0.0	14.7
Recycled water percolation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recycled water in storage		10.3	13.4	14.7	13.0	11.3	7.5	3.8	1.0	0.0	0.9	3.5	7.0	--
Groundwater to irrigation		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Notes:

Potable water use (acre-feet per year):	45.8
Recycled water storage capacity (Mgal):	4.8

Table A-5. Monthly Groundwater Balances under Project Conditions: Phase 1, 70-85-85 Occupancy

Inflow or Outflow Item	Existing Conditions	Project Conditions	Monthly Flow or Storage (acre-feet)												Total
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Inflows															
Rainfall and irrigation deep percolation															
Nonirrigated areas	22.8	1.4	0.3	0.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Irrigated areas	0.0	22.7	0.9	1.3	1.7	0.4	2.6	3.1	4.0	4.0	2.8	1.8	0.0	0.0	22.7
Impervious areas	0.0	24.7	4.9	7.4	9.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7
Stream percolation	7.2	7.2	1.4	2.2	2.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
Groundwater inflow from hillslope recharge	710.2	710.2	49.2	59.2	69.2	76.5	79.2	76.5	69.2	59.2	49.2	41.9	39.2	41.9	710.2
Hydrothermal groundwater inflow	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Wastewater percolation	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total inflows	796.9	822.6	61.4	75.2	88.9	85.0	86.5	84.3	77.9	67.9	56.6	48.4	43.9	46.6	822.6
Outflows															
Well pumping															
Indoor uses	0.2	19.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	19.2
Irrigation															
Turf	0.0	10.6	0.0	0.0	0.0	0.0	0.7	2.9	2.8	2.3	1.4	0.4	0.0	0.0	10.6
Vineyard	0.0	2.6	0.0	0.0	0.0	0.0	0.2	0.7	0.7	0.6	0.4	0.1	0.0	0.0	2.6
General	0.0	2.7	0.0	0.0	0.0	0.0	0.2	0.8	0.7	0.6	0.4	0.1	0.0	0.0	2.7
Water treatment	0.0	1.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.0
Spring discharge (Hot Spring well)	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Evapotranspiration															
Freshwater marsh	1.8	1.8	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.0	0.0	1.8
Riparian wetland	0.5	0.5	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.5
Seasonal wetlands	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Net evaporation from ornamental pond and small recirculating water features	0.0	1.1	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	1.1
Groundwater outflow	737.7	726.7	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.6	60.6	726.7
Total outflows	796.9	822.6	66.9	66.9	66.9	67.4	68.5	72.0	71.8	71.0	69.5	67.8	66.9	66.9	822.6
Inflows - outflows	0.0	0.0	-5.5	8.2	22.0	17.6	17.9	12.3	6.1	-3.0	-12.9	-19.4	-23.1	-20.4	0.0
Cumulative groundwater storage change	0.0	0.00	8.22	16.47	38.47	56.04	73.98	86.33	92.47	89.44	76.57	57.19	34.13	13.75	
Seasonal water-level fluctuation (ft)															10.2

Notes:

Total groundwater pumping (AFY)	36.1
Change in groundwater outflow (AFY)	-11.0

Table A-6. Monthly Groundwater Balances under Project Conditions: Phase 1, 85-100-100 Occupancy

Inflow or Outflow Item	Existing Conditions	Project Conditions	Monthly Flow or Storage (acre-feet)												Total
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Inflows															
Rainfall and irrigation deep percolation															
Nonirrigated areas	22.8	1.4	0.3	0.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Irrigated areas	0.0	22.7	0.9	1.3	1.7	0.4	2.6	3.1	4.0	4.0	2.8	1.8	0.0	0.0	22.7
Impervious areas	0.0	24.7	4.9	7.4	9.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7
Stream percolation	7.2	7.2	1.4	2.2	2.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
Groundwater inflow from hillslope recharge	710.2	710.2	49.2	59.2	69.2	76.5	79.2	76.5	69.2	59.2	49.2	41.9	39.2	41.9	710.2
Hydrothermal groundwater inflow	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Wastewater percolation	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total inflows	796.9	822.6	61.4	75.2	88.9	85.0	86.5	84.3	77.9	67.9	56.6	48.4	43.9	46.6	822.6
Outflows															
Well pumping															
Indoor uses	0.2	22.8	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	22.8
Irrigation															
Turf	0.0	8.3	0.0	0.0	0.0	0.0	0.0	2.1	2.6	2.1	1.2	0.2	0.0	0.0	8.3
Vineyard	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.5	0.3	0.0	0.0	0.0	2.0
General	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.5	0.3	0.0	0.0	0.0	2.1
Water treatment	0.0	1.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.1
Spring discharge (Hot Spring well)	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Evapotranspiration															
Freshwater marsh	1.8	1.8	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.0	0.0	1.8
Riparian wetland	0.5	0.5	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.5
Seasonal wetlands	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Net evaporation from ornamental pond and small recirculating water features	0.0	1.1	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	1.1
Groundwater outflow	737.7	726.4	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	726.4
Total outflows	796.9	822.7	67.2	67.2	67.2	67.7	67.8	71.0	71.8	71.0	69.5	67.8	67.2	67.2	822.7
Inflows - outflows	0.0	0.0	-5.8	7.9	21.7	17.3	18.7	13.3	6.1	-3.0	-12.9	-19.4	-23.3	-20.7	0.0
Cumulative groundwater storage change	0.0	0.00	7.90	15.89	37.60	54.88	73.56	86.90	93.04	90.00	77.12	57.74	34.39	13.72	
Seasonal water-level fluctuation (ft)															10.3

Notes:

Total groundwater pumping (AFY)	36.4
Change in groundwater outflow (AFY)	-11.3

Table A-7. Monthly Groundwater Balances under Project Conditions: Buildout, 70-85-85 Occupancy

Inflow or Outflow Item	Existing Conditions	Project Conditions	Monthly Flow or Storage (acre-feet)												Total
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Inflows															
Rainfall and irrigation deep percolation															
Nonirrigated areas	22.8	1.4	0.3	0.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Irrigated areas	0.0	22.7	0.9	1.3	1.7	0.4	2.6	3.1	4.0	4.0	2.8	1.8	0.0	0.0	22.7
Impervious areas	0.0	24.7	4.9	7.4	9.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7
Stream percolation	7.2	7.2	1.4	2.2	2.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
Groundwater inflow from hillslope recharge	710.2	710.2	49.2	59.2	69.2	76.5	79.2	76.5	69.2	59.2	49.2	41.9	39.2	41.9	710.2
Hydrothermal groundwater inflow	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Wastewater percolation	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total inflows	796.9	822.6	61.4	75.2	88.9	85.0	86.5	84.3	77.9	67.9	56.6	48.4	43.9	46.6	822.6
Outflows															
Well pumping															
Indoor uses	0.2	38.6	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	38.6
Irrigation															
Turf	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vineyard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
General	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water treatment	0.0	1.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.9
Spring discharge (Hot Spring well)	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Evapotranspiration															
Freshwater marsh	1.8	1.8	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.0	0.0	1.8
Riparian wetland	0.5	0.5	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.5
Seasonal wetlands	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Net evaporation from ornamental pond and small recirculating water features	0.0	1.1	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	1.1
Groundwater outflow	737.7	722.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	60.2	722.2
Total outflows	796.9	822.6	68.3	68.3	68.3	68.7	68.8	68.9	68.9	68.8	68.7	68.6	68.3	68.3	822.6
Inflows - outflows	0.0	0.0	-6.9	6.9	20.7	16.3	17.6	15.5	9.1	-0.9	-12.1	-20.2	-24.4	-21.7	0.0
Cumulative groundwater storage change	0.0	0.00	6.92	13.83	34.51	50.76	68.41	83.87	92.94	92.07	80.02	59.85	35.47	13.77	
Seasonal water-level fluctuation (ft)															10.4

Notes:

Total groundwater pumping (AFY)	40.6
Change in groundwater outflow (AFY)	-15.5

Table A-8. Monthly Groundwater Balances under Project Conditions: Buildout, 85-100-100 Occupancy

Inflow or Outflow Item	Existing Conditions	Project Conditions	Monthly Flow or Storage (acre-feet)												Total
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Inflows															
Rainfall and irrigation deep percolation															
Nonirrigated areas	22.8	1.4	0.3	0.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
Irrigated areas	0.0	22.7	0.9	1.3	1.7	0.4	2.6	3.1	4.0	4.0	2.8	1.8	0.0	0.0	22.7
Impervious areas	0.0	24.7	4.9	7.4	9.9	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7
Stream percolation	7.2	7.2	1.4	2.2	2.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
Groundwater inflow from hillslope recharge	710.2	710.2	49.2	59.2	69.2	76.5	79.2	76.5	69.2	59.2	49.2	41.9	39.2	41.9	710.2
Hydrothermal groundwater inflow	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Wastewater percolation	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total inflows	796.9	822.6	61.4	75.2	88.9	85.0	86.5	84.3	77.9	67.9	56.6	48.4	43.9	46.6	822.6
Outflows															
Well pumping															
Indoor uses	0.2	45.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	45.8
Irrigation															
Turf	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vineyard	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
General	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Water treatment	0.0	2.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.3
Spring discharge (Hot Spring well)	56.5	56.5	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	56.5
Evapotranspiration															
Freshwater marsh	1.8	1.8	0.0	0.0	0.0	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.0	0.0	1.8
Riparian wetland	0.5	0.5	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.5
Seasonal wetlands	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Net evaporation from ornamental pond and small recirculating water features	0.0	1.1	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.0	0.0	1.1
Groundwater outflow	737.7	714.7	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	59.6	714.7
Total outflows	796.9	822.7	68.3	68.3	68.3	68.7	68.8	68.9	68.9	68.8	68.7	68.6	68.3	68.3	822.7
Inflows - outflows	0.0	0.0	-6.9	6.9	20.7	16.2	17.6	15.5	9.1	-0.9	-12.0	-20.2	-24.4	-21.7	0.0
Cumulative groundwater storage change	0.0	0.00	6.88	13.82	34.49	50.74	68.39	83.85	92.91	92.04	79.99	59.82	35.43	13.73	
Seasonal water-level fluctuation (ft)															10.4

Notes:

Total groundwater pumping (AFY)	48.1
Change in groundwater outflow (AFY)	-23.0