APPENDIX A

Cambria Emergency Water Supply Project San Simeon Creek Basin Groundwater Modeling Report

Exhibit 10.2

Cambria Community
Services District

Cambria Emergency Water Supply Project

San Simeon Creek Basin Groundwater Modeling Report

Cambria, California
May 2014

CDM Smith

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The information contained in the document titled "Cambria Emergency Water Supply Project San Simeon Creek Basin Groundwater Modeling Report" dated May 2014 has received appropriate technical review and approval. The conclusions and recommendations presented represent professional judgments and are based upon findings from the investigations and sampling identified in the report and the interpretation of such data based on our experience and background. This acknowledgement is made in lieu of all warranties, either expressed or implied. The activities outlined in this report were performed under the supervision of a California Registered Professional Engineer.

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Acronyms/Abbreviations

AF	acre-feet
CCSD	Cambria Community Services District
MGD	million gallons per day
MSL	mean sea level
NAVD 1988	North American Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
TDS	total dissolved solids
USGS	Unites States Geological Survey
VDF	Variable-Density Flow Process
WRIR	Water Resources investigation Report

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Section 1 Introduction

1.1 General Setting

This investigation is being conducted for the Cambria Community Services District (CCSD), which provides water, and collects and treats wastewater for the town of Cambria and adjacent service areas. The area of specific interest in this investigation is the lower portion of the San Simeon Creek valley, extending about 3.5 miles upstream from the Pacific Ocean. The study area and major features are shown on **Figure 1-1**.

The study area includes areas underlain by a significant alluvial aquifer along San Simeon Creek, including the Van Gordon Creek tributary. Near the headwaters, the creek valley forms a steep, narrow canyon. Along the final three to five miles before reaching the ocean, the valley widens to a floodplain that is up to approximately one thousand feet wide. The floodplain is underlain by the groundwater basin and is flanked by steep hillsides that rise 200 to 800 feet above the valley floor. A fresh water lagoon is present in the lower portion of the valley that serves as an important ecological resource. This lagoon forms behind an ocean beach berm and is supported by groundwater discharge and surface water inflows.

CCSD and agricultural water users along San Simeon Creek use wells in the alluvial aquifer. Groundwater occurs in the alluvial deposits beneath the creek, which drains the western flanks of the Santa Lucia Range in San Luis Obispo County and discharges into the Pacific Ocean. The alluvial deposits form flat valley floors, which are used for irrigated agriculture. The alluvial aquifer is recharged primarily by seepage from San Simeon Creek, which typically flows during the winter and spring rainy season.

The CCSD has a well field consisting of four potable water supply wells located approximately one mile inland from the ocean. They also utilize a series of percolation ponds between the well field and the ocean where secondary treated waste water is recharged back to the aquifer. Pumping during the dry season results in seasonal declines in groundwater levels since production is supported by removal of water from storage in the aquifer when the stream is not flowing.

Numerous private wells are present that irrigate farmlands on flat areas adjacent to the creek bottoms. Native vegetation consists of trees, grass, and shrubs that grow along the creeks and field borders. Grassy hillsides along the sides of the valleys are used for grazing. San Simeon State Park occupies the western extent of the basin and includes a large campground, which obtains its water supply from the CCSD.

1.2 Study Objectives

Extended drought conditions in the central coastal area of California have persisted over the past year, which have resulted in a limited water supply for the CCSD well field. Studies have been ongoing to identify additional water sources for the CCSD including indirect potable reuse of the percolated secondary effluent. However, the persistent drought conditions have elevated concern on availability of a reliable water supply since water levels continue to decline as aquifer storage is depleted. This groundwater modeling study has been developed to support evaluation of the basin water management alternatives to develop additional water supplies for CCSD to meet the emergency conditions. The specific objectives of this San Simeon Basin Groundwater Modeling study are provided below.

1. Develop a groundwater model that is consistent with data from the United States Geological Survey (USGS) WRIR 98-4061 model (Yates and Van Konyenburg, 1998) and the 2007 modeling analysis (Yates, 2007) to allow assessment of potential emergency water supply alternatives focusing on recovery of brackish basin water near the current percolation ponds.

2. The evaluation will consider the impacts of vertical flow and density driven flow in the evaluation of alternatives.

3. The evaluation will assess residence times prior to recovery of treated wastewater effluent as part of the alternatives evaluation.

4. The model will evaluate impacts of emergency water supply alternatives on San Simeon Creek, and the fresh water lagoon area.

The evaluation will be based on available existing data, as supplemented by stream elevation survey and select water quality data that are currently being collected.

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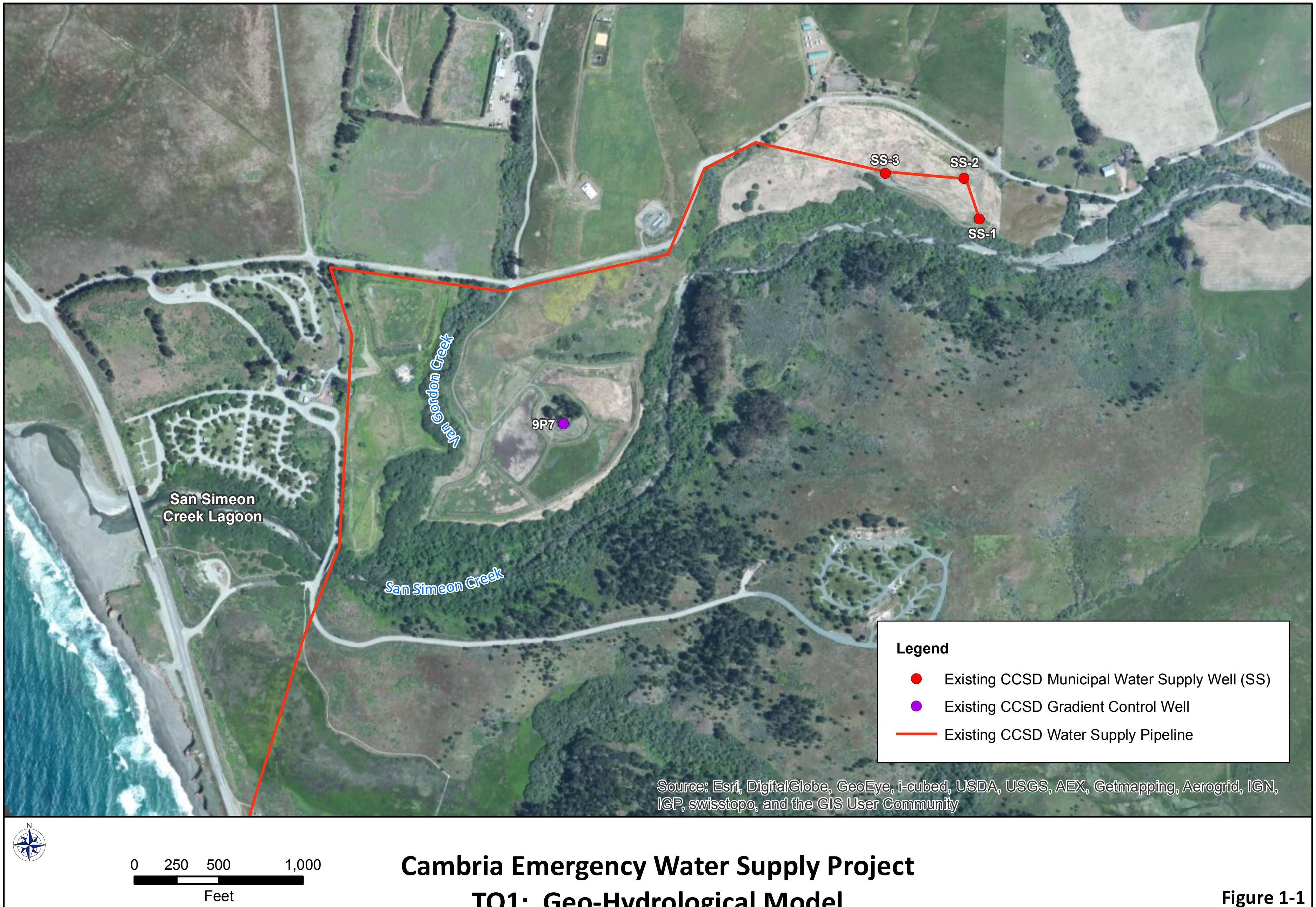

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Figure 1-1
Location of Study Area with Significant Site Features

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Section 2 Conceptual Model

The basin conceptual model documents the current understanding of the aquifer system at the site and includes the data that are available to support this interpretation. This site conceptual model is based on the 1998 USGS report (Yates and Van Konynenburg, 1998), supplemented by additional data that have been collected since the late 1980s. This conceptual model is used to support development of the groundwater model that will be used for assessment of emergency water supply alternatives. Subsequent sections describe the nature and extent of the aquifer system, sources of recharge and discharge, current aquifer use and a water budget.

2.1 Aquifer System Framework

The aquifer system framework describes the physical configuration of the alluvial aquifer, including its areal extent, thickness and the lithology of the aquifer materials. The alluvial aquifer in the San Simeon valley consists of sands and gravels with interbedded finer grain lithologies filling the bedrock valley of San Simeon Creek and the lower portion of Van Gordon Creek. This alluvial aquifer extends to approximately elevation -120 feet or deeper in its western extent, and likely extends to the off-shore area, since the extent of the bedrock valley was influenced by lower sea level elevations in the geologic past.

Figure 2-1 shows the location of wells and borings for which geologic information is available, with the path of the cross-section provided on **Figure 2-2**, which show information based on boring logs, with generalized interpretation of lithology between the boring locations. The alluvium west of the confluence with Van Gordon Creek contains a larger percentage of fine grain material interbedded with more permeable zones and may act as a confining to semi-confining unit for the deeper zones.

Figure 2-3 provides a geologic map produced by the US Geological Survey (Hall, et. al., 1979). This map shows the extent of alluvial deposits in the San Simeon valley and adjacent areas, along with the bedrock geology. Several faults have been mapped or inferred in the bedrock units, however, the USGS concluded that they do not impact the alluvial deposits, so they are not expected to impact the hydrogeology of the alluvial aquifer (Yates and Van Konynenburg, 1998).

The Hosgri fault zone is located sub-parallel to the coastline is this area and is about two miles off-shore. This zone was identified as seismically active (Yates and Van Konynenburg, 1998). However, due to its distance from the San Simeon valley alluvial aquifer, it is not anticipated to impact the hydrology of the basin.

Bedrock units consist of highly fractured Franciscan rocks that are hydraulically connected to the alluvial basin, however, their permeability is much lower than the alluvial aquifer and the bedrock has a limited role in the hydrology of the basin, providing a limited amount of recharge to the alluvium that is described in a later section.

Figure 2-4 shows the elevation of the bedrock surface that was interpreted from borings in the basin in the 1998 USGS report (Yates and Van Konynenburg, 1998). This bedrock surface forms the lower boundary of the alluvial groundwater system.

2.2 Groundwater Occurance and Flow

The alluvium in the San Simeon basin is saturated, with groundwater near the ground surface at its western extent. During the periods when water is present in San Simeon Creek, groundwater levels are similar to those observed in the creek. The depth to groundwater increases away from the creek, since in many areas of the valley the creek is incised below the adjacent terrace areas.

Groundwater levels decline during the dry periods of the year and in response to pumping. Water levels are mounded in the vicinity of the percolation ponds that are operated by the CCSD. A generalized water table configuration for the winter of 1989 is provided on **Figure 2-5**, showing the down valley flow direction.

The average hydraulic gradient down the valley is about 0.006 ft/ft, with increased gradients in areas where the width of the bedrock valley narrows (Yates and Van Konynenburg, 1998). Water level elevations monitored at wells range from about 52 feet (NAVD 1988) to slightly above sea level at the western extent. Vertical head differences can be observed at two locations, near the shoreline at well 8R3, and at adjacent shallow and deep piezometers at 9N2 and 9N3.

The 8R3 well has one interval screened in bedrock at depth of 130 to 140 feet, and a shallower zone screened in the deep portion of the alluvial aquifer from 92 to 102 feet. Water levels in the two intervals at 8R3 were very similar and do not suggest the presence of a significant gradient between the fractured bedrock and the alluvial aquifer.

Water levels at the 9N2/9N3 location showed a significant downward gradient present, with the shallow well showing an elevation of 18.37 feet, while the deep well had a water level elevation of 8.29 feet (NAVD 1988). The water table elevation at the shallow well is considerably higher than other wells, suggesting that this is a perched interval that is affected by the nearby percolation pond or Van Gordon Creek and not representative of the principal aquifer system. This is consistent with the inter-bedded lithology logged in the adjacent well in the upper 20 feet, where well 9N3 is screened.

A fresh water lagoon is present at the western extent of the valley that appears to be in hydraulic communication with groundwater, since it has water present through most years and has a water level similar to the adjacent well 8R3.

2.3 Hydraulic Properties

Hydraulic characteristics of interest include the hydraulic conductivity, storage coefficient, specific yield and effective porosity. Limited characterization has been conducted in past studies, primarily quantifying hydraulic conductivity using pumping tests at seven wells located along the length of the valley. **Figure 2-6** shows the location of aquifer tests and the hydraulic conductivity that was reported in the 1998 USGS report (Yates and Van Konynenburg, 1998).

Responses of water levels in wells to stream stage changes were also used to estimate hydraulic properties, however, these estimates yield a composite of storage coefficient and transmissivity, so it is difficult to estimate hydraulic conductivity due to the highly variable storage coefficient, which could range from the specific yield to a confined or semi-confined range.

The results of the stream interaction estimates did indicate that the aquifer is highly permeable. The horizontal hydraulic conductivity estimated from pumping tests ranged from 99 to 413 ft/day. The geometric mean of the hydraulic conductivity is 220 ft/day. **Figure 2-7** shows the statistical distribution of hydraulic conductivity values.

The reported storage coefficients in the USGS Study were low compared to typical estimates for an unconfined sand and gravel aquifer. This is likely due to the short term nature of the aquifer tests, use of the pumping well response for analysis and the presence of finer grain interbeds, which would lead to a confined to semi-confined response rather than physical drainage of pore space in the aquifer. Based on the lithology of the aquifer, an estimate of 0.1 to 0.2 is estimated for the specific yield and the effective porosity of the aquifer at the site, based on typical values estimated for this type of aquifer.

Estimating the effective porosity from the specific yield is a conservative approach, since the effective porosity is likely to be higher than specific yield, which is the drainable portion of the pore space. Some moisture will be retained under gravity drainage that will contribute to groundwater flow. A lower effective porosity will result in a higher groundwater velocity, which is conservative for this analysis.

2.4 Boundary Conditions

Boundary conditions describe sources of water inflow and outflow to the basin, and include recharge, subsurface inflow from surrounding bedrock areas, pumping, stream inflows, outflows and seepage, evapotranspiration from groundwater, interaction with the ocean and percolation from wastewater treatment plant effluent disposal ponds. This section describes each of these elements, while the following section presents estimates of each of the water budget components.

2.4.1 Recharge

2.4.1.1 Recharge from Precipitation

Precipitation is estimated using the data from the San Luis Obispo–Poly Station, which was selected for use in the 1998 USGS report (Yates and Van Konynenburg, 1998). Mean annual precipitation for the period 1870–2013 was 21.93 inches. Rainfall increases with distance from the shoreline in this area, estimates increasing to 40 to 50 inches in headwater areas east of the basin of interest.

Figure 2-8 shows the long term precipitation trend near the site, indicating that precipitation has been significantly lower than the long term average for the last decade. The majority of the annual rainfall occurs between November and April. Deep percolation of precipitation past the root zone will recharge the aquifer and only occurs during significant precipitation events when soil moisture is above field capacity and available moisture exceeds evapotranspiration demands.

Most recharge from precipitation occurs in irrigated areas, since the native vegetation areas only meet these conditions during periods of average or greater precipitation. Evaluations during the USGS study period for the 1998 report, using data from 1988 and 1989, indicated no significant recharge occurred in the native vegetation areas (Yates and Van Konynenburg, 1998). This report estimated that the quantity of recharge under average conditions originating from precipitation within the basin at 50 acre-feet (AF)/year, which corresponds to 0.75 inches of recharge, or 3.4 percent of the precipitation.

2.4.1.2 Recharge from Irrigation Return Flows

Irrigated agriculture is practiced within a significant portion of the basin. The 1998 USGS report estimated that 37 percent of the applied water returned to the groundwater system as deep percolation, which is reasonable for the flood irrigation practices in the late 1980s. Since that period, irrigation practices have changed and more efficient sprinkler and drip systems are now used. A return flow percentage of 15 percent of the applied water for current irrigation practices is estimated, based on professional judgment.

2.4.1.3 Lateral Boundary Inflow

An additional source of water entering the system originates as discharge from surrounding fractured bedrock. This term is difficult to determine from field measurements, but was estimated in the 1998 USGS report at 150 AF/year (Yates and Van Konynenburg, 1998). This term was estimated from the contributing tributary areas of bedrock adjacent to the study area and modified downward based on the calibration conducted by the USGS.

2.4.1.4 Stream Channel Seepage

The most significant source of recharge to the aquifer system is seepage from the San Simeon Creek channel during runoff periods. Water levels in the basin recover rapidly with the onset of stream flow in the fall and winter and decline when stream flow ceases in the spring. Stream flows during the 2009 to 2013 time period are shown on **Figure 2-9.** The quantity of recharge from the stream is a function of the period of time that the stream is flowing and the amount of pumping that is occurring in the aquifer.

2.4.1.5 Waste Water Percolation Pond Recharge

Much of the water that is produced by the CCSD is returned after receiving secondary treatment to the lower part of the basin by discharging to a series of four percolation ponds. The quantity of water discharged to the percolation ponds during the period 2009–2013 is shown on **Figure 2-10**. This water infiltrates to the alluvial aquifer except for a small percentage that is lost to evaporation. The average discharge during the 2009 to 2013 period was 0.56 million gallons per day (MGD).

2.4.2 Discharge

2.4.2.1 Municipal Pumping

The CCSD maintains a potable water supply well field in the San Simeon basin that provides a significant portion of the water to the Cambria community. Additional water for the CCSD system is obtained from the Santa Rosa basin. In addition to the water supply pumping, a gradient control well is periodically pumped as needed to maintain an adequate westerly gradient from the CCSD well field toward the percolation ponds to avoid inducing flow of treated wastewater back toward the well field. **Figure 2-11** shows the average monthly pumping rates from the CCSD well field during 2009–2013. The average production rate from the San Simeon well field over this period was 0.51 MGD.

2.4.2.2 Agricultural Pumping

The alluvial aquifer is used for irrigation within the valley. The agricultural pumping during the late 1980s was estimated in the USGS report at 450 AF/year (Yates and Van Konynenburg, 1998). During an update to this analysis in 2007, this production was estimated at 180 AF/year, based on changes in irrigation practices and interviews with water users. (Yates, 2007)

2.4.2.3 Evapotranspiration from Groundwater

Limited evapotranspiration from groundwater occurs in areas where groundwater levels are near the surface in riparian areas near the channel of San Simeon Creek. This term was estimated at 30 AF/year in the USGS report (Yates and Van Konynenburg, 1998).

2.4.2.4 Discharge to Surface Water

Water in the aquifer will discharge to the surface water system during periods when the groundwater levels are higher than adjacent stream levels. This occurs primarily in the lower extent of the basin extending from the location of the percolation ponds to the ocean. **Figure 2-12** shows the locations where water was present in the San Simeon Creek channel during February 2014, indicating that groundwater discharge was occurring in these reaches. Elevations of the water surface (NAVD 1988) are shown on the figure.

These observations were made during a period when there had been no precipitation for multiple months. In addition, there is significant subsurface outflow to the ocean that occurs from the basin. This quantity was estimated by the USGS at 320 AF/year by calibration of their model (Yates and Van Konynenburg, 1998). Mean sea level in this area is 2.82 feet referenced to the NAVD 1988 datum used in this report. Mean seawater level was interpolated between the primary NOAA tidal stations at Port San Luis and Monterey (Yates, 2014 personal communication).

2.5 Water Budget

A basin water budget summarizes the components of inflow and outflow to the aquifer at the project site. The water budget from the 1998 WRIR report is summarized on **Table 2-1** and represents averages for the late 1980s period that was used in the USGS analysis.

Current practices have decreased agricultural pumping and return flows, and the CCSD now uses percolation ponds rather than the spray irrigation that was used in the late 1980s. The net inflows and outflows were balanced using estimates of the uncertain terms, primarily ocean outflow, resulting in an overall net inflow to the basin of 1760 AF/year with an equivalent outflow of the same quantity. The USGS estimates of areal recharge and lateral boundary inflow were retained for the current study, the remaining components were based on updates from the 2007 study (Yates, 2007), and flow records maintained by the CCSD. Components that cannot be measured with available field data, such as the ocean outflow and stream gains and losses were calculated in the model.

Table 2-1 Alluvial Aquifer Annual Water Budget Estimates from 1988 USGS Study

Budget Item	Inflow (AF)	Outflow (AF)	Net flow (AF)
Rainfall recharge	50		50
Stream Seepage	950	-410	540
Subsurface Inflow and Outflow			
Lateral Boundary Inflow	150		150
Ocean Boundary Outflow		-320	-320
Agricultural Water Use			
Pumping		-450	-450
Irrigation Return Flow	170		170
Nonagricultural Water Use			
CCSD Pumping		-550	-550
Rural Pumping		<-10	<-10
CCSD Percolation	440		440
Septic Tanks	<10		<10
Evapotranspiration		-30	-30
Change in Storage			0
Totals:	**1760**	**-1760**	**0**

Note: From Yates(1998)

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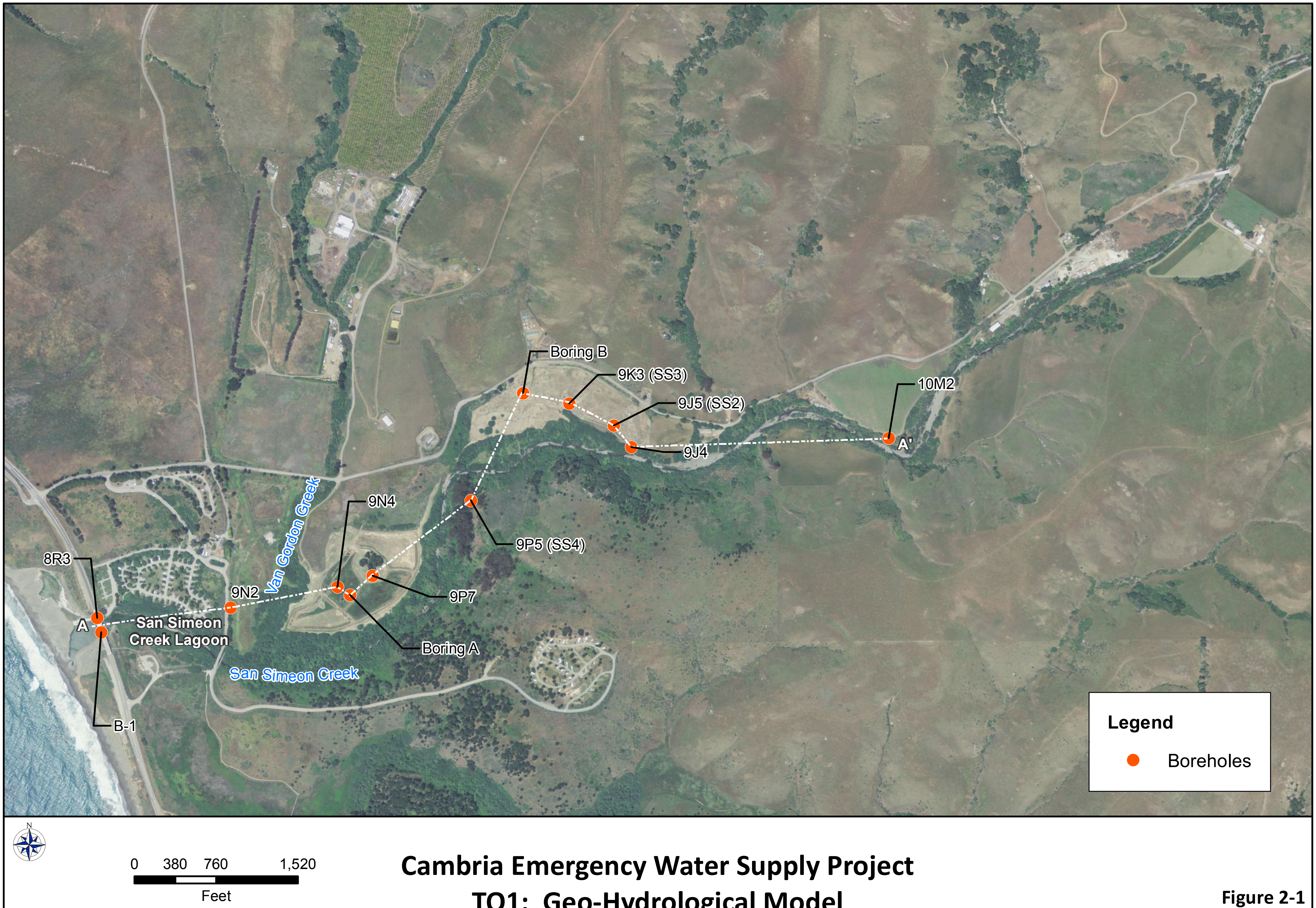

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Figure 2-1
Location of Wells and Borings with Lithologic Data

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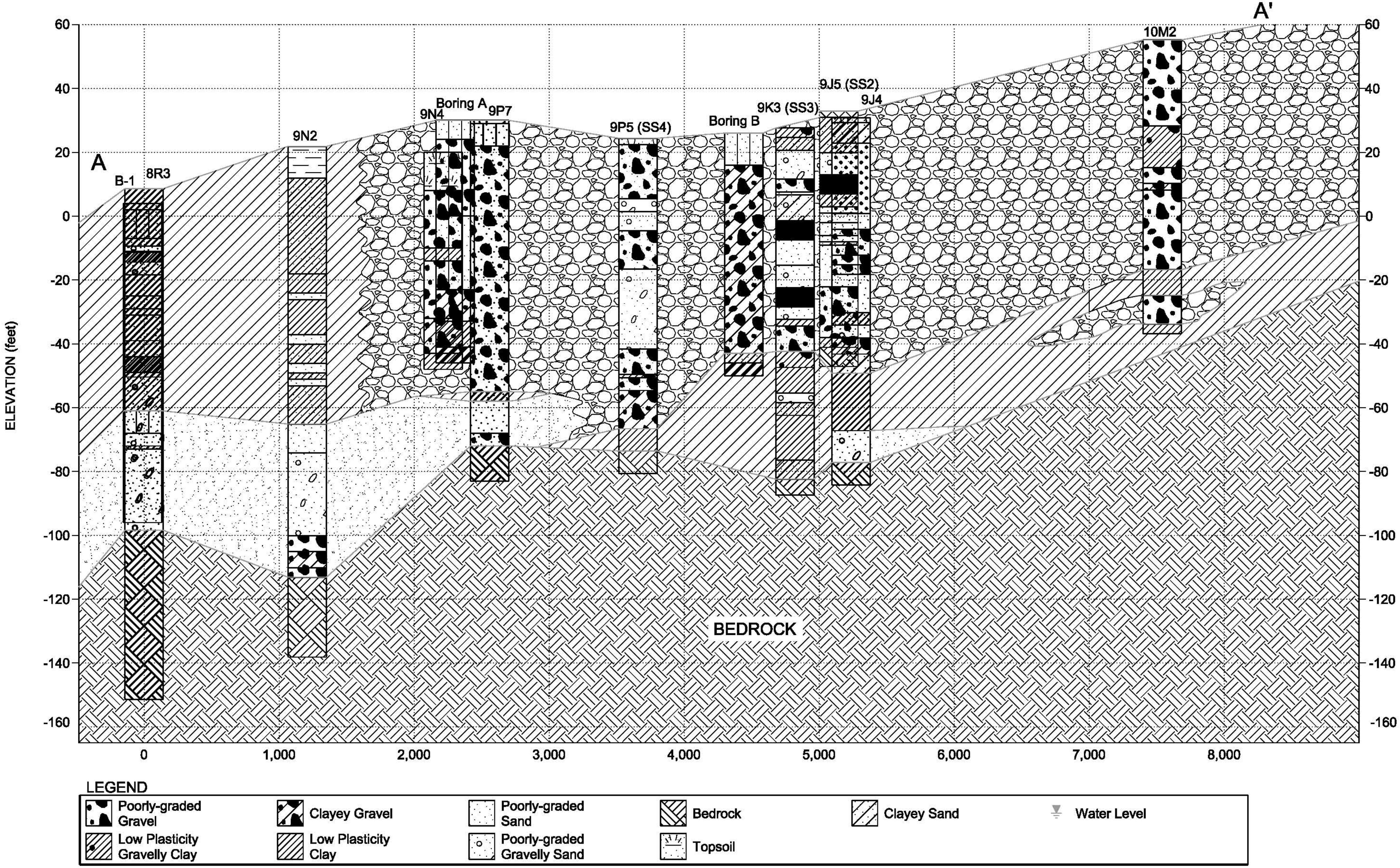

Note: Geologic interpretation based on boring logs developed by the USGS and from Drillers logs.

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Figure 2-2
Geologic Cross-Section of San Simeon Valley Alluvium

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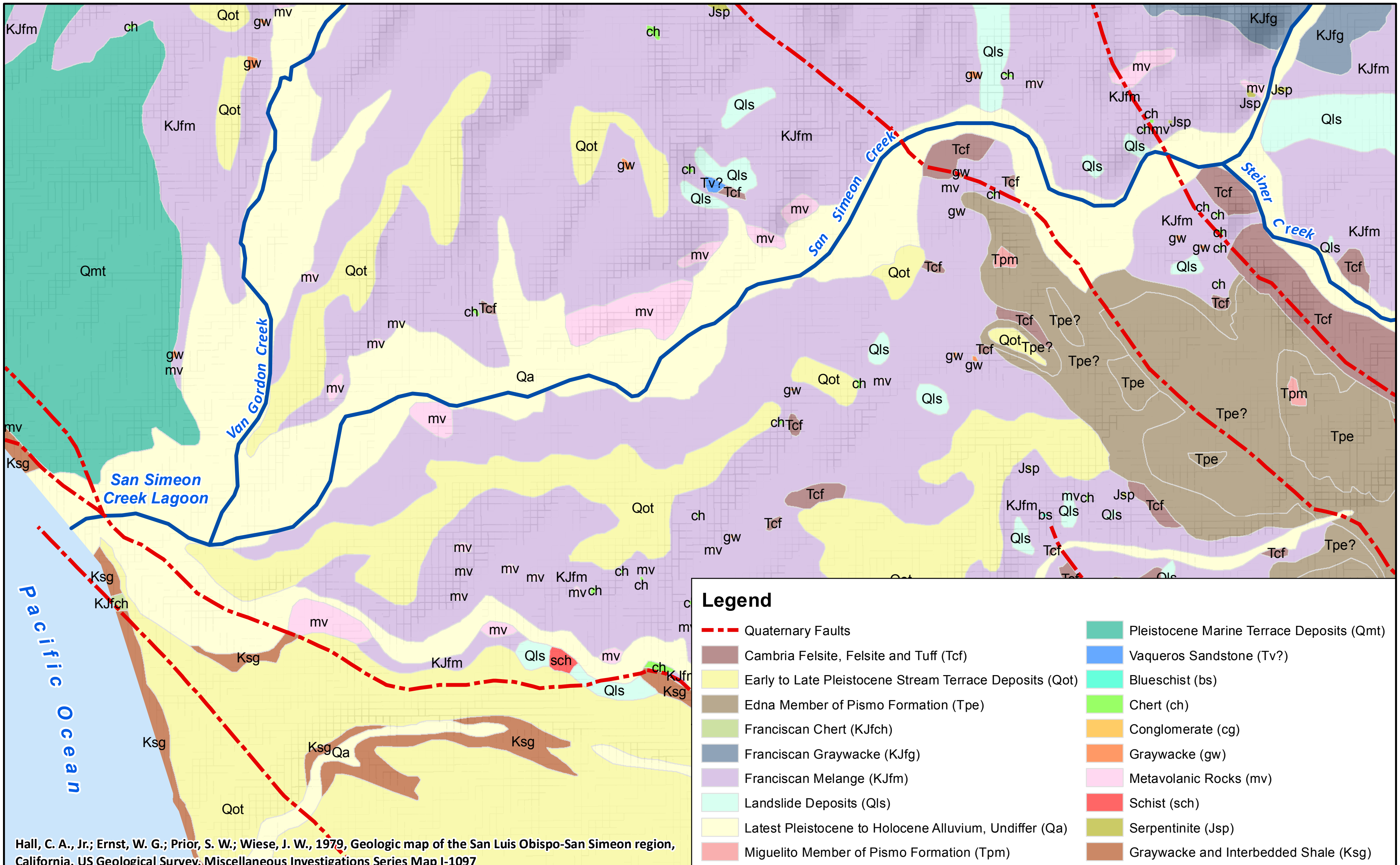

0 600 1,200 2,400
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Figure 2-3
Geologic Map of the San Simeon Creek Area

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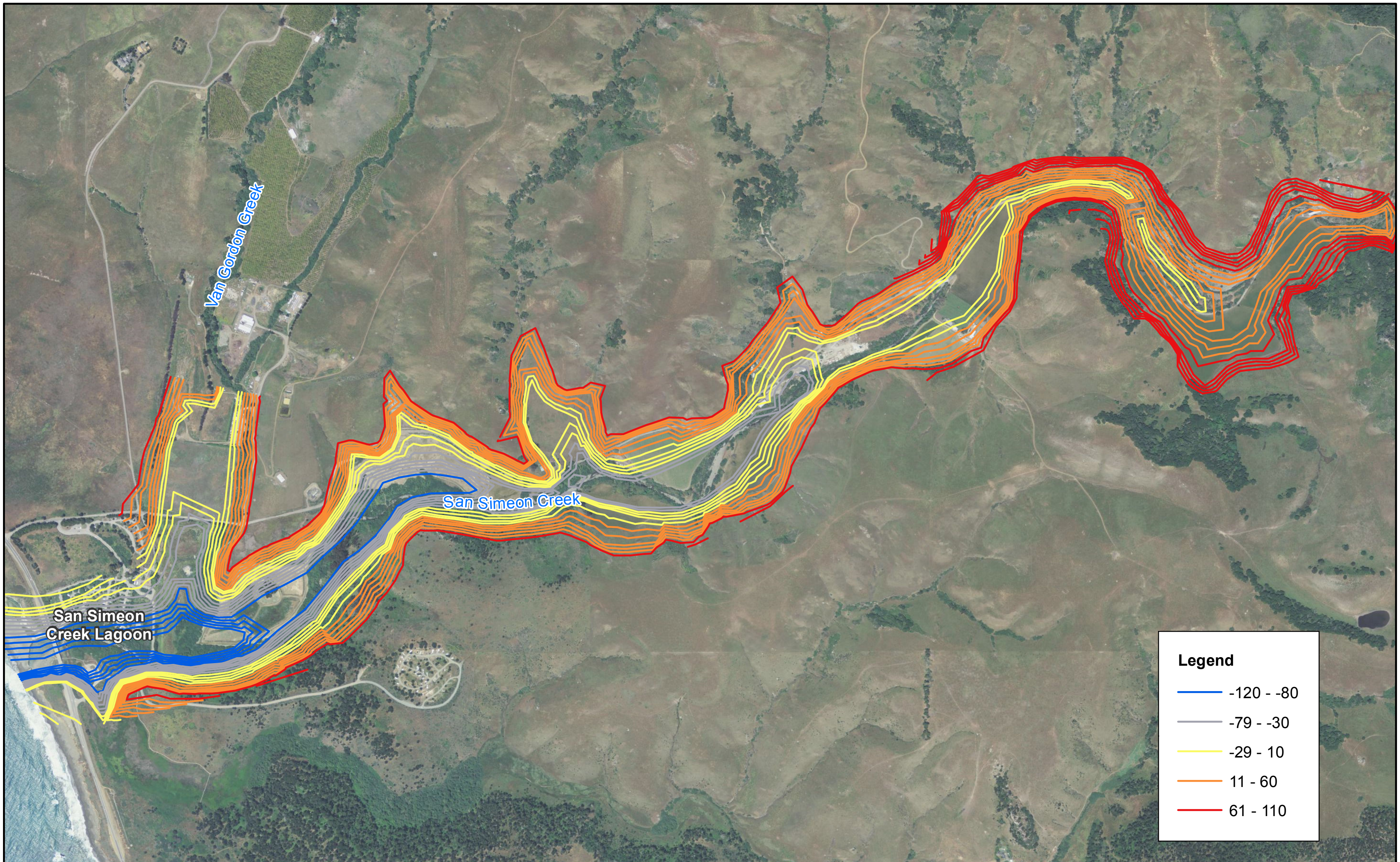

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Figure 2-4
Interpreted Bedrock Surface Elevation below the San Simeon Basin Alluvial Aquifer

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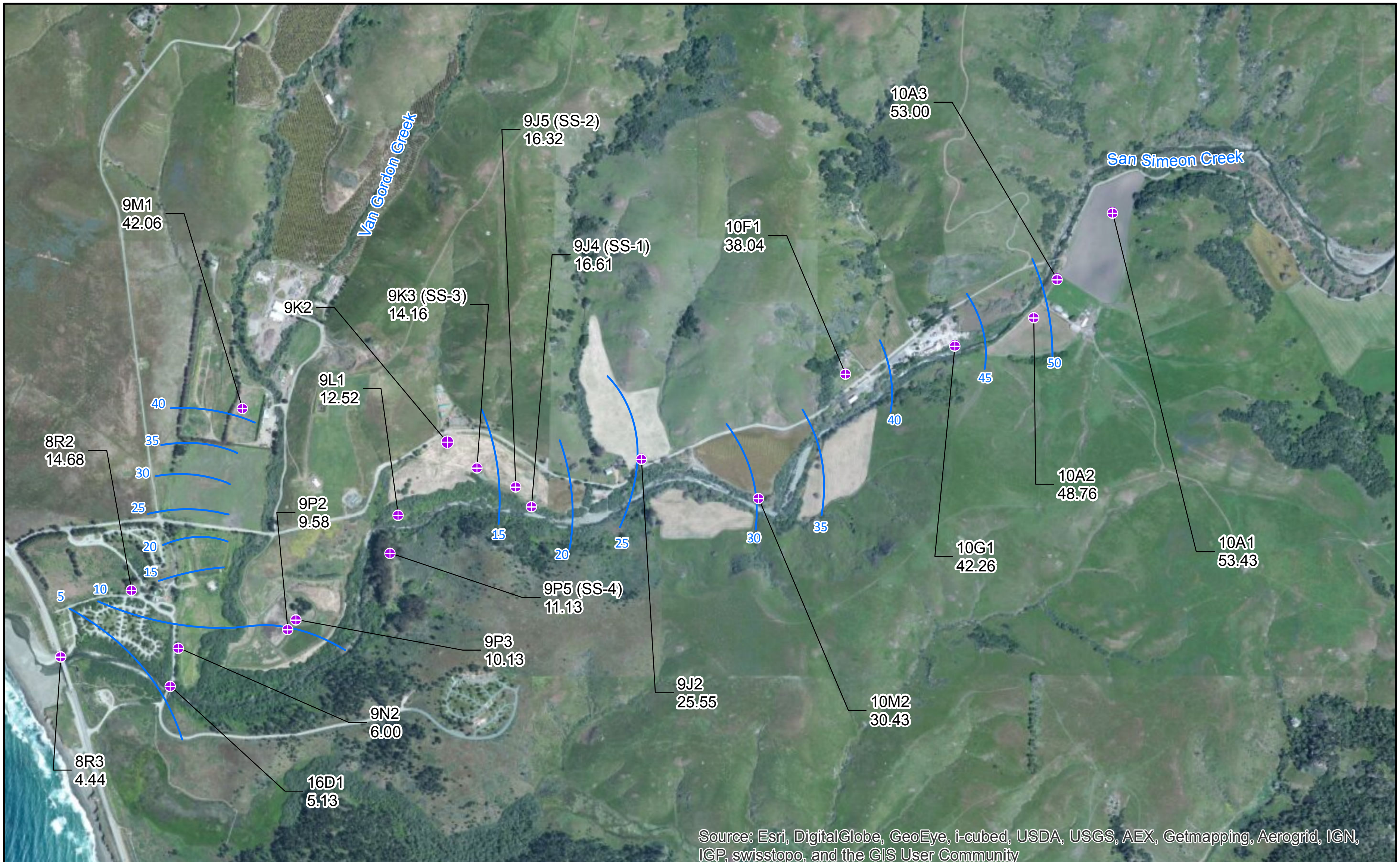

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Elevations are in NAVD88 datum.

Figure 2-5
Generalized Water Table – Winter 1989

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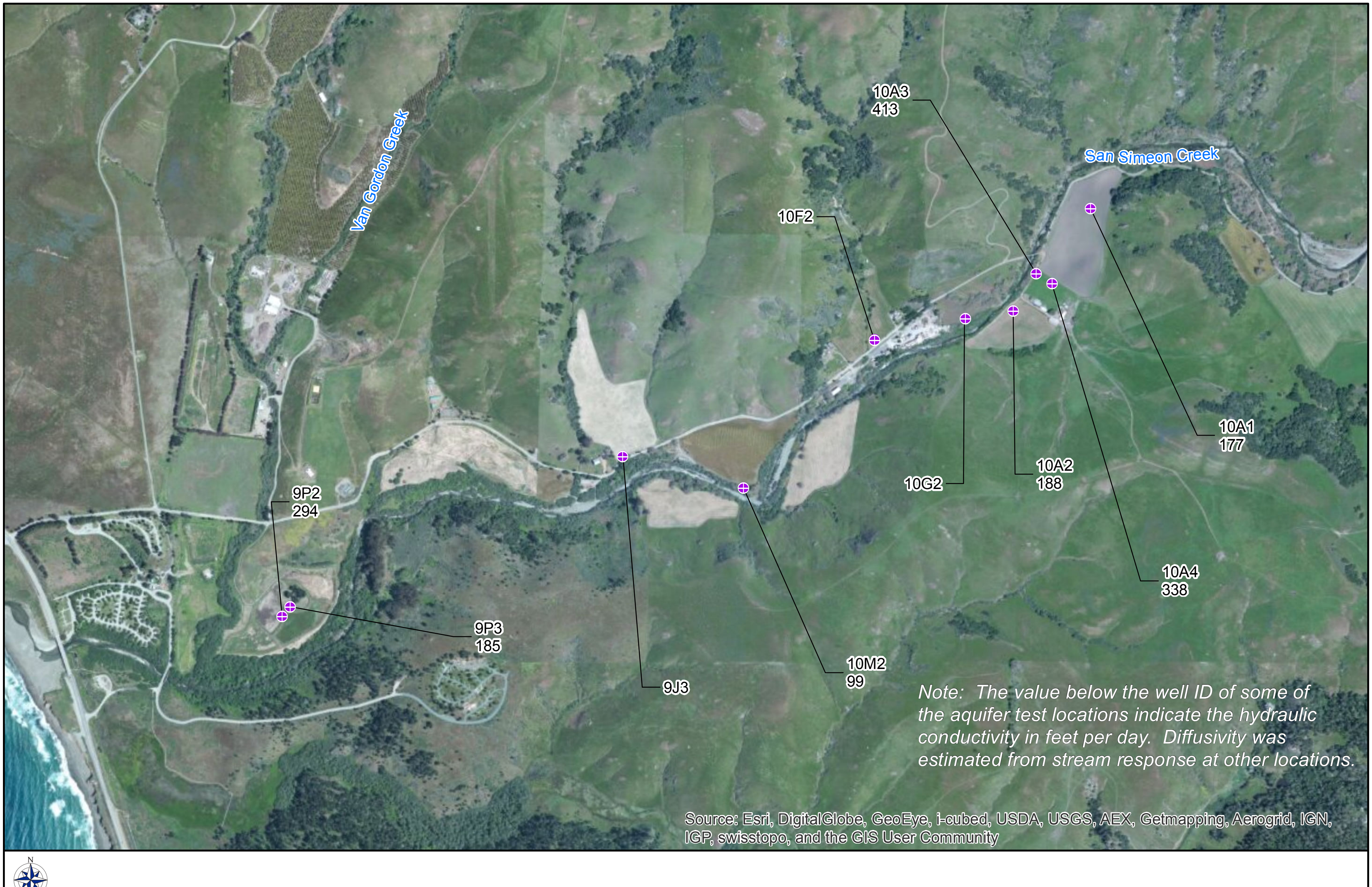

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Figure 2-6
Location of Aquifer Tests

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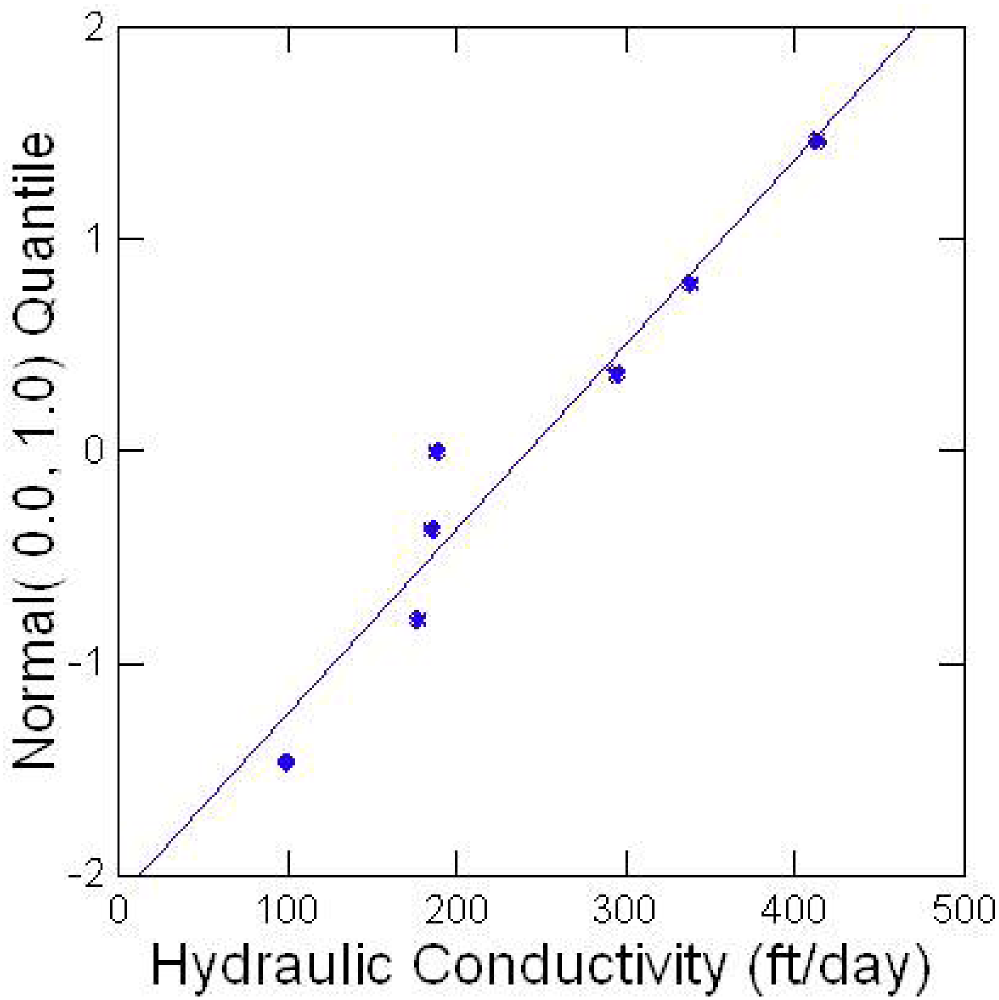

Note: Blue dots represent conductivity value from the 1998 USGS Report.

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Figure 2-7
Hydraulic Conductivity Statistical Distribution

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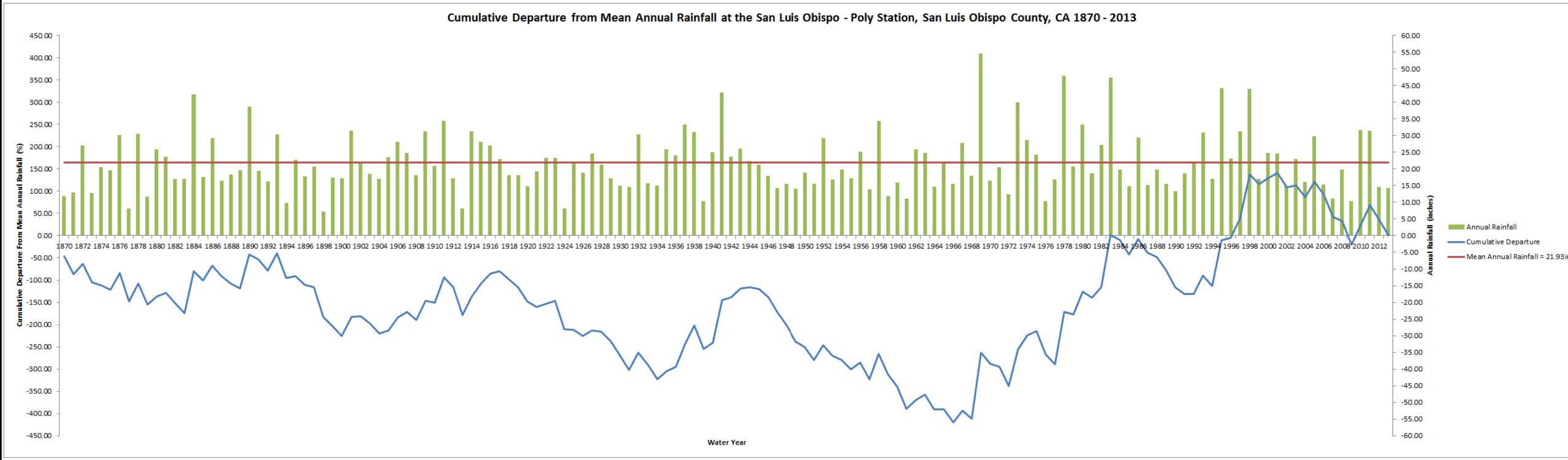

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Figure 2-8
Precipitation and Cumulative Departure
from the Long Term Average at San Luis Obispo - Poly Station

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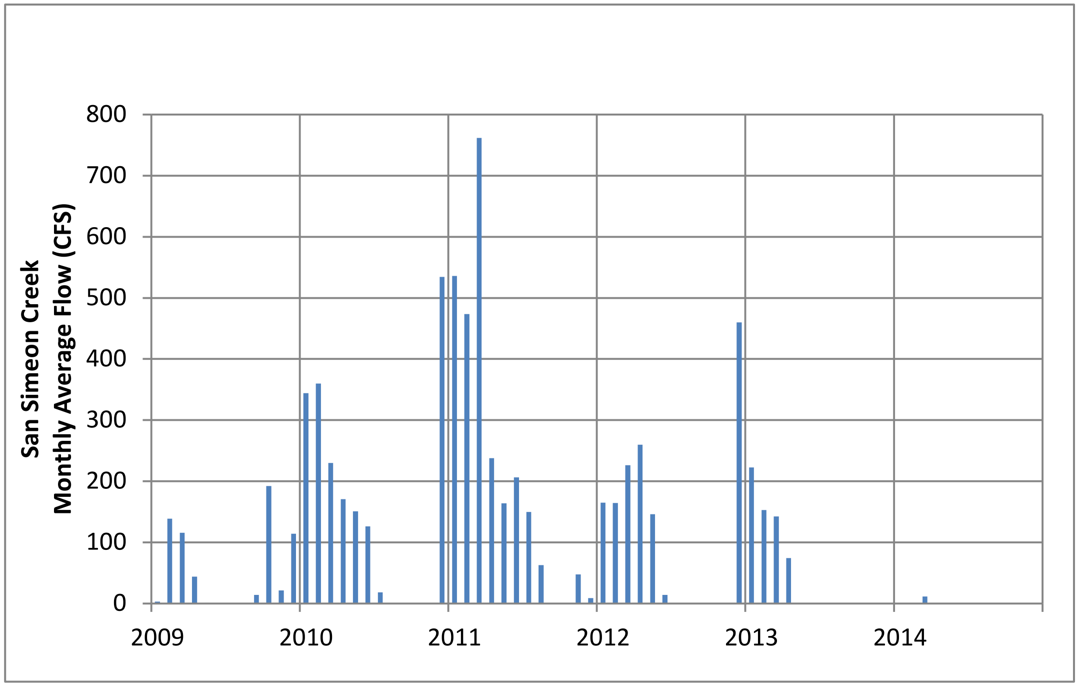

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Figure 2-9

Streamflow in San Simeon Creek and Groundwater Level Hydrographs in the 2009 - 2013 Period

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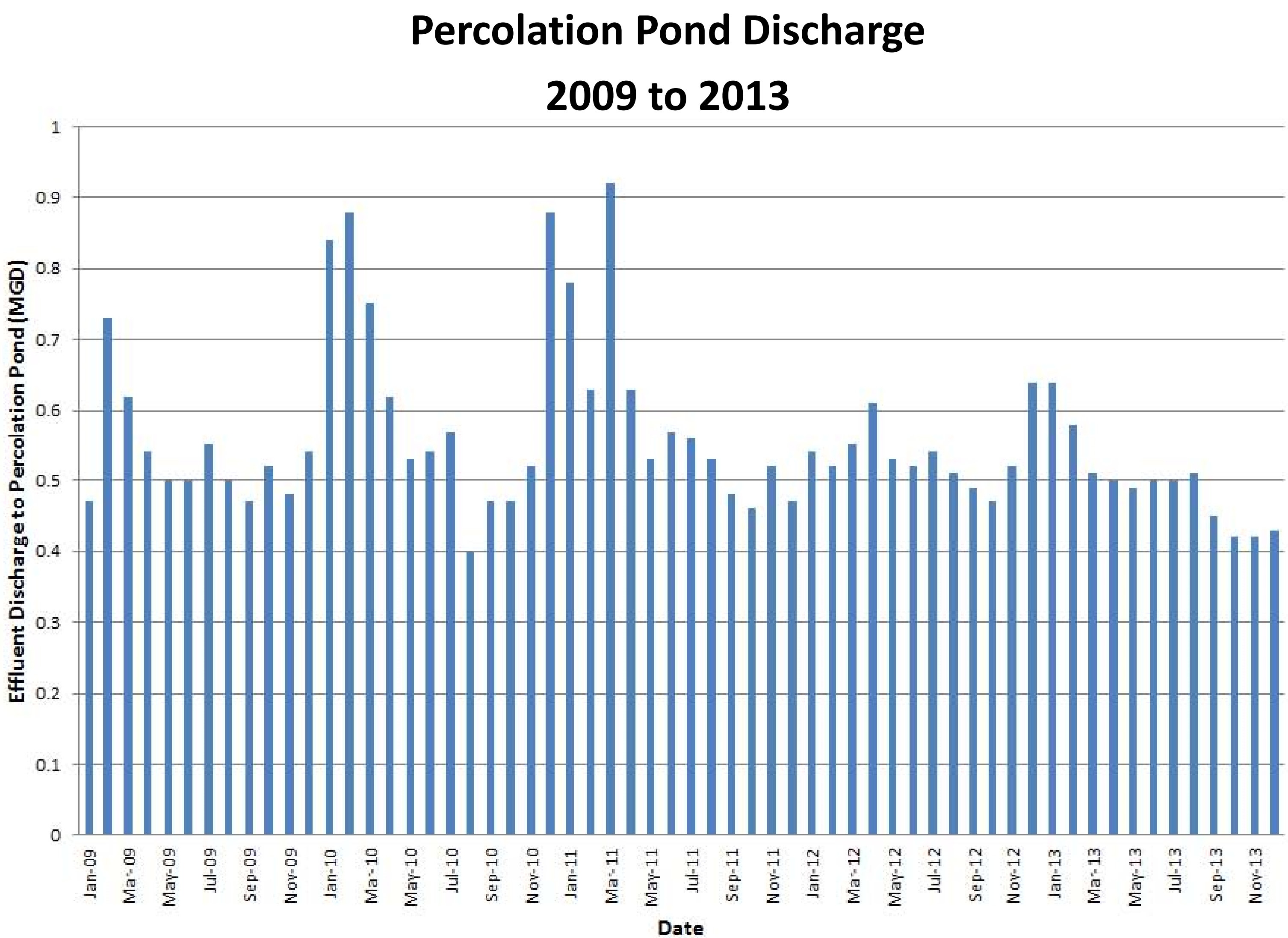

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Figure 2-10

Pecolation Pond Secondary Effluent Discharge 2009 to 2013

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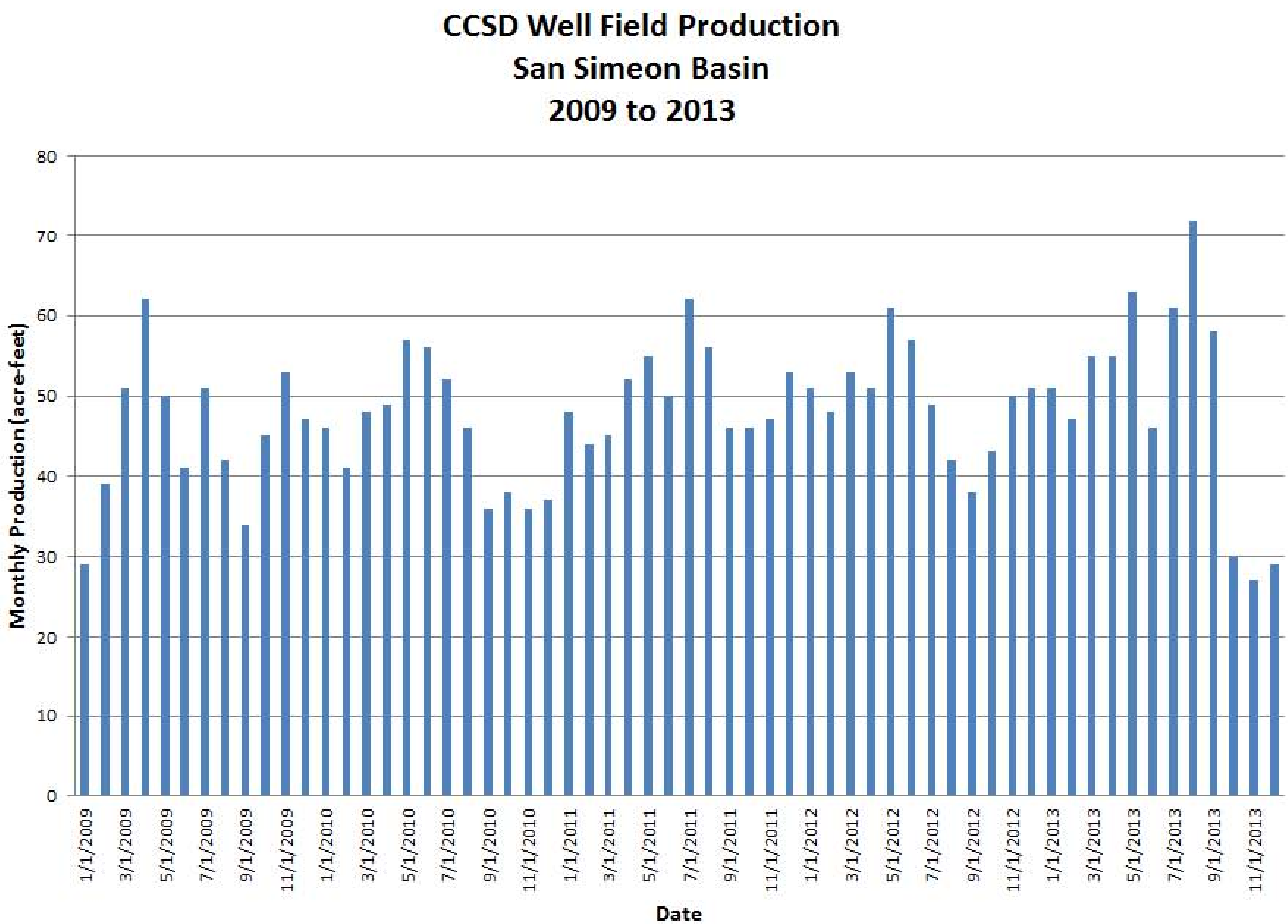

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Figure 2-11

CCSD San Simeon Basin Well Field Production 2009 to 2013

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Figure 2-12
Location of Surface Water - February 2012

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Section 3
Computer Model Code Selection

This modeling evaluation has been conducted using industry standard, open source, government developed computer programs that are able to mathematically represent the processes of interest. Detailed descriptions of these modeling programs are provided in the cited references and will not be repeated. The specific elements that are used in this application are described in the model development section. In addition, preparation of model data sets and post processing of model output was facilitated through use of a commercial graphical user interface. The selected programs are listed below.

MODFLOW-2000 (Harbaugh, 2000), this finite difference model is the most widely used program for modeling of groundwater flow and serves as the basis for flow calculations in the additional programs that are used in the analysis. This program was developed by the US Geological Survey and includes capabilities for simulation of all of the components of interest in this investigation, except for density driven flow, which is handled in the companion program SEAWAT. MODFLOW-2000 is well documented by the USGS.

MT3DMS. (Zheng, 1999), this code was developed under contract from the US Environmental Protection Agency and the US Army Corps of Engineers. This model is an industry standard model used for simulation of transport of dissolved constituents in groundwater. This code is incorporated into the SEAWAT model.

SEAWAT. (Langevin, 2003), SEAWAT is a modification of MODFLOW-2000 and MT2DMS that allow simulation of groundwater flow, including the effects of variable density and transport of solutes. This industry standard model was developed by the USGS. This model was used to assess the importance of density driven flow for comparison with the primary simulations in MODFLOW and MT3DMS.

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Section 4
Ground-Water Flow Model Construction

The basin conceptual model described in Section 2 was used to configure a numerical flow model in MODFLOW-2000 and to set up transport capabilities in MT3DMS and SEAWAT. This section describes the configuration of the model framework, selection of simulation packages to represent the site processes and parameter selection.

4.1 Model Grid

A very fine computational grid was defined to represent the aquifer system at the site, since a major concern is the simulation of transport and consideration of vertical movement of recharge or injected water. The alluvial aquifer is represented by 18 vertical layers at the western limit of the site, decreasing to 8 active layers in the eastern portion of the site where the aquifer is thinner and more distant from the area of interest. The horizontal spacing for grid cells was maintained at a uniform size of 40 by 40 feet, resulting in a grid with 120 rows and 460 columns.

The grid was rotated to approximately parallel the trend of the San Simeon basin. Cells outside of the aquifer footprint and in deeper portions of the grid in the eastern part of the model were inactivated. **Figure 4-1** shows the extent of the model, while **Figure 4-2** shows the model grid in the area of primary concern between the CCSD well field and the wastewater percolation ponds.

4.2 Hydraulic Parameters

A groundwater model must define hydraulic characteristics for each active cell in the grid in order to evaluate flow and transport. These hydraulic characteristics include horizontal and vertical hydraulic conductivity and storage characteristics of the aquifer material. A detailed calibration of hydraulic characteristics was done for a model of the basin in 2007 (Yates, 2007) that was used as the basis for initial configuration of hydraulic characteristics for the alluvial aquifer.

This model was configured in a similar manner to leverage the calibration that was done at that time. Minor refinements were incorporated in some areas, however, variation in hydraulic conductivity during the evaluation of calibration did not result in significant improvements, so the hydraulic conductivity distribution remained very similar to the 2007 configuration. A detailed calibration for development of specific yield, which is important in assessing the volume of water in storage, for assessment of groundwater velocities and estimation of residence time of injected fluids was done.

The hydraulic properties were grouped vertically for definition of hydraulic properties, with an upper zone incorporating layers 1–8, and intermediate zone represented by layers 9–12, and a deep zone for layers 13–18. Properties within each of the layer groupings were uniform. The base of the upper zone was set at an elevation-20, or the bedrock elevation for cases where bedrock was above this elevation. The intermediate zone extended from elevation -20 to elevation -60, again truncating at the bedrock contact if it was shallower. The deep zone extended from -60 to the bedrock contact. In cases where the bedrock contact was above the noted elevations, then underlying layers were inactivated in the model. The active extent of the model grid therefore extended from the water table to the bedrock contact.

Figure 4-3, thru **Figure 4-5** show the distribution of horizontal hydraulic conductivity for the upper, middle and deep zones respectively. The distribution of hydraulic conductivity incorporates the conceptual model characteristic of a lower permeability zone in shallow materials in the western extent of the model down-gradient of the confluence of Van Gordon Creek. A constant ratio of horizontal to vertical hydraulic conductivity of 10:1 was used throughout the model domain. The initial specific yield was set to 0.12, with changes that were incorporated during calibration described in subsequent sections.

4.3 Boundary Conditions

Boundary conditions describe characteristics that control inflow and outflows of water to and from the aquifer system. As described in the conceptual model, the primary sources of water entering the system are recharge from stream seepage, infiltration of precipitation and irrigation return flows, waste water percolation and lateral boundary inflow.

The primary discharge from the aquifer includes stream seepage in the western portion of San Simeon Creek, municipal and agricultural pumping and subsurface discharge to the ocean. These boundary conditions are configured in standard packages within MODFLOW-2000, as described below.

Boundary conditions are specified for individual stress periods, which are a duration over which a given stress is assumed to be constant. For this model, the stress periods for both calibration and assessment of alternatives was specified as a calendar month. These stress periods are subdivided during computations into smaller time increments to facilitate the calculations.

4.3.1 Recharge Package

The recharge package in MODFLOW-2000 allows specification of a time variant rate of flow, expressed as a depth of water per unit of time that is applied to the model at the highest active layer. This model package was used to represent the following sources of recharge:

- Recharge from native precipitation,
- Recharge from irrigation return flows,
- Recharge from lateral boundary inflows, and
- Waste water percolation.

Waste water percolation was the only parameter in the recharge package that incorporated time variation, annual averages for the other parameters were used, since transport time through the unsaturated zone will tend to even out the small surface recharge sources. The recharge from native precipitation and irrigation return flows was evenly allocated through the basin, with an estimated 50 AF of recharge from precipitation, and the irrigation return flows estimated at 15 percent of the applied water. This recharge quantity was set to a constant value of 2.05 inches/year. The lateral boundary inflow component, representing subsurface inflows from surrounding bedrock areas was estimated at 150 AF/year (Yates and Van Konynenburg, 1998), and this quantity was distributed to the outermost cells in the model. During drought simulations, described in later sections, these recharge quantities were reduced.

The CCSD maintains records of discharge to the waste water percolation ponds, see **Figure 4-6**, that were used to determine the recharge quantity infiltrating to the aquifer. These recorded quantities were applied to the entire footprint of the ponds. Some consumptive use of this water would occur due to evaporation, however, it is a relatively small percentage of the applied water, so this was not included. Previously presented Figure 2-10 shows the quantity of wastewater that was discharged to the ponds during the 2009 to 2013 period. This quantity of flow was converted to a depth for use in the model, allocating the flow over the entire area of the pond. Actual operations tend to use only a single pond, moving the discharge to different ponds to maintain infiltration capacity.

4.3.2 Stream Flow Routing Package

The stream flow routing package in MODFLOW-2000 is used to simulate the surface water component in the model. This package maintains a mass balance between the stream flow and gains and losses to groundwater. When the groundwater level is below the stream stage, as occurs during the beginning of the runoff season, water will infiltrate from the stream into groundwater. Conversely, during times when the groundwater level is above the stream stage, groundwater will discharge to the stream. This occurs in the lower reaches of San Simeon Creek as a result of operations at the percolation pond.

Water level observations show that groundwater is rapidly replenished when runoff begins in San Simeon Creek. **Figure 4-7** shows the groundwater elevations at wells 9K2 and 9L1 compared with flows in San Simeon Creek demonstrating this rapid recharge. The stream flow routing package is configured to provide little resistance to flow between groundwater and surface water. **Figure 4-8** shows the location of the stream boundary conditions. Channel and water surface elevations were surveyed to obtain accurate information for the model. Flow rates for San Simeon Creek were obtained from a stream gage maintained by San Luis Obispo County located near the CCSD well field. This flow was assumed to be representative of inflow at the upper reach of the model, since during times when the stream is flowing the discharge rates are significantly higher than potential seepage rates. The stream conductance term was set to a high value based on the observed rapid response of water levels to stream flow. No calibration was done for this parameter.

4.3.3 Lake (Fresh Water Lagoon) Package

The fresh water lagoon is highly connected with the groundwater and surface water systems at the site. Flow in San Simeon Creek discharges to the upper extent of the lagoon. When groundwater is higher than the lagoon stage, discharge will occur from the aquifer to the lagoon. Since the berm impounding the lagoon is periodically breached during higher flow periods or storms, low permeability sediment is potentially eroded from the base of the lagoon, resulting in probable high connectivity between the lagoon and groundwater in some areas.

The lake package was configured to reflect a high degree of connection between the lake and groundwater. Figure 4-8 shows the location of the fresh water lagoon and associated streams. An outlet stream was used to simulate conditions when the lagoon discharges to the ocean. The water surface and lagoon bottom was surveyed to obtain accurate location and elevation information. No data were available to allow calibration of leakage parameters for the lagoon. During transport and variable density simulations the stream package was used to represent this feature to maintain compatibility with the model codes.

4.3.4 Constant Head Package

The hydraulic connection with the ocean is simulated using constant head boundary conditions in the off-shore area. The boundary associated with the ocean was simulated using the equivalent fresh water head to account for the density difference with sea water. For the SEAWAT simulations, the density is internally accounted for in the program. **Figure 4-9** shows the location of the constant head boundaries. The constant head in layer 1 was set over the off-shore portion of the model, while deeper zones were represented as line sources at the western extent of the model. Since sea water is denser than fresh water, the pressure in deeper zones is greater than would be present if the overlying water were fresh. For example, the equivalent fresh water head in the aquifer at a depth of 100 feet in the sea water saturated portion of the aquifer would be 2.57 feet higher.

4.3.5 Well Package

Pumping of groundwater for irrigation and municipal use is simulated using the MODFLOW-2000 well package. This package removes a specified quantity of water that is distributed across model layers corresponding to well screen intervals. The flow was specified proportional to the hydraulic conductivity and thickness of individual layers that correspond to the reported screen intervals.

Estimates of agricultural pumping were developed in the 2007 study based on land use and water user interviews (Yates, 2007). Production records from CCSD were used for the municipal pumping rates. **Figure 4-10** shows the location of pumping wells that were included in the model. Total agricultural pumping occurs during the growing season from June through October, with an average of 180 AF per year of groundwater produced. The CCSD production from the San Simeon basin is limited to 454 gpm (0.635 MGD) during the dry season. The recent pumping was previously presented on Figure 2-11. Well 9P7, located in the percolation pond area, is periodically pumped to maintain a seaward gradient from the well field. However, detailed records of pumping from this well are not available.

4.4 Transport Packages

Analysis of transport of dissolved constituents was conducted using MT3DMS, which uses information from MODFLOW to define flow terms and physical characteristics. The primary additional parameters necessary for transport analysis include effective porosity, which is important in determine groundwater velocity, and dispersivity. Dispersivity is a parameter used to describe the spread of a solute in three dimensions due to small scale variations in groundwater velocity and localized flow directions.

Literature data were used to estimate the dispersivity parameter as a function of transport distance for sensitivity analysis. The selected value for longitudinal dispersivity was 67 feet, 6.7 feet for transverse dispersivity and .67 feet for vertical dispersivity. Effective porosity, which is a measure of the open pore space through which water actively flows, was estimated based on specific yield, which provides a lower limit estimate of the effective porosity.

Simulation of the selected emergency water supply alternative using the variable density package in SEAWAT was also conducted to assess the importance of variable density flow to confirm results of fresh water equivalent head simulations.

4.5 Selection of Calibration Targets

Model calibration is the process of adjustment of model parameters to match model results with field observations. The available information at the site was assessed to identify field measurements that can be used to assess model calibration. The model is configured with known information, as identified in the site conceptual model and in the descriptions provided above.

Parameters in the model that have the greatest uncertainty are selected for adjustment in the process of calibration. The principal data available for comparisons between field measurements and model calculated results are water levels at wells. The CCSD has a comprehensive water level monitoring program in place that records water levels twice per month at available wells. Climatic information was examined to select a period that encompassed a range in rainfall quantity during a period where information on pumping and wastewater discharge was available, along with water level measurements.

The 2001–2002 period was selected for this analysis. **Figure 4-11** shows the location of wells with water level measurement. The water level records were screened to remove wells that had been recently pumped to obtain a data set representative of aquifer conditions for use in the calibration process. This resulted in a total of 411 water level measurements at 13 wells distributed in the San Simeon basin.

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Exhibit 10.2

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Figure 4-1
Model Grid

CDM Smith

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Exhibit 10.2

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Figure 4-2
Detail Area Showing Model Grid

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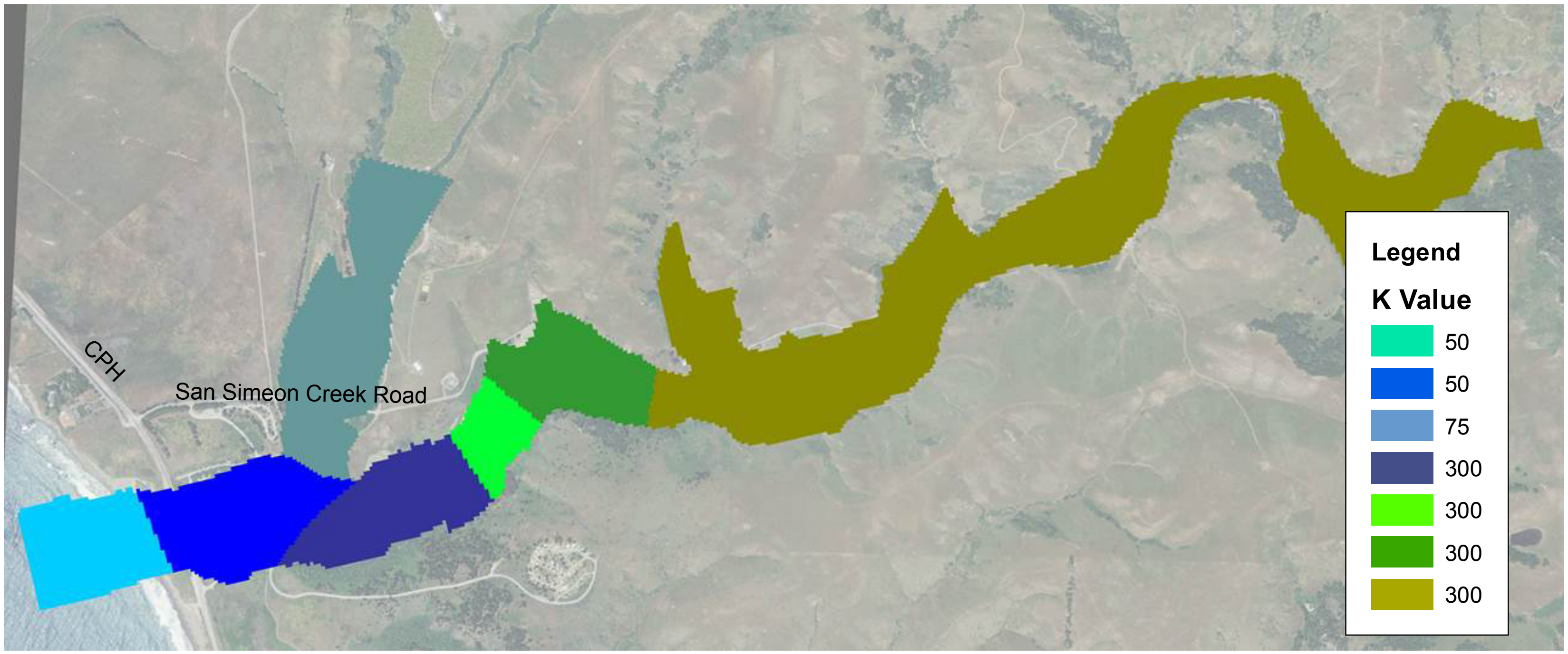

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Figure 4-3
Upper Zone Hydraulic Conductivity Distribution

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Figure 4-4
Middle Zone Hydraulic Conductivity Distribution

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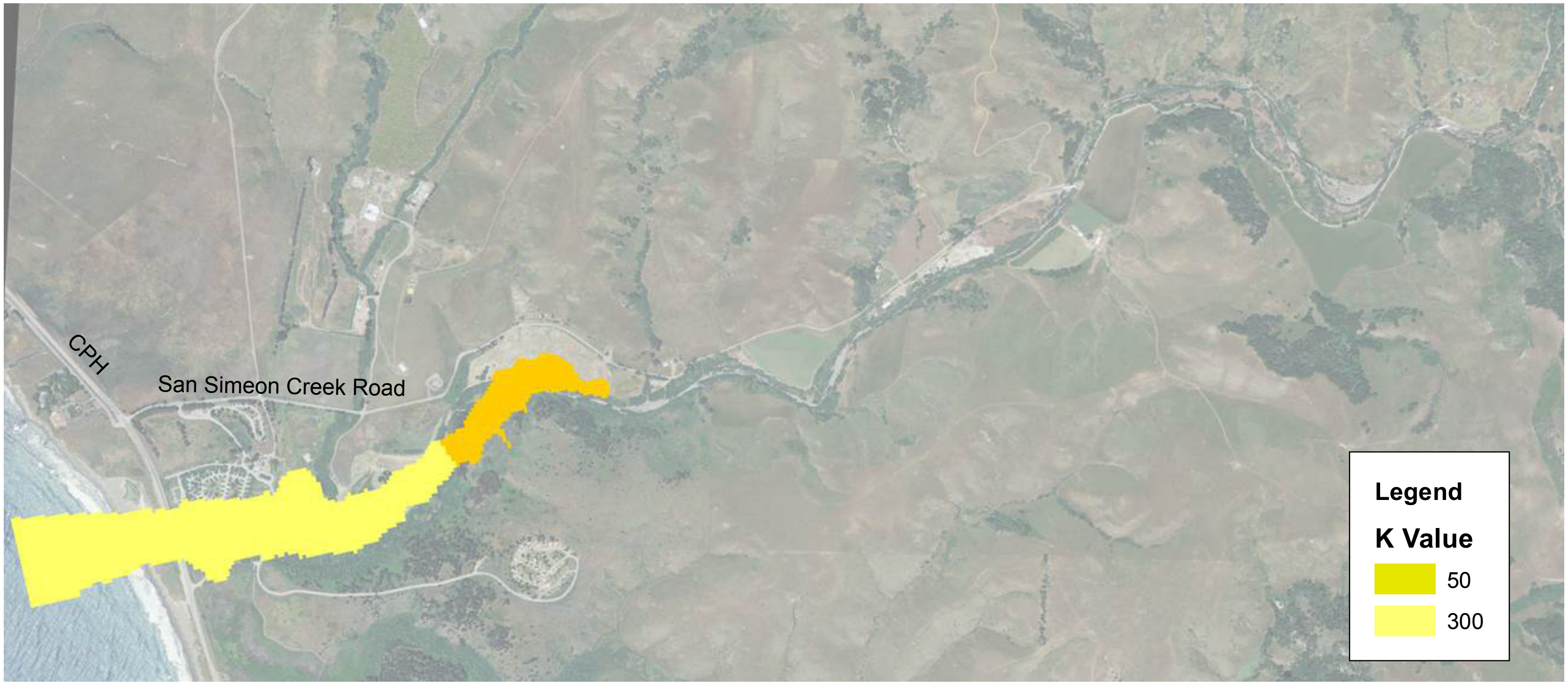

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Figure 4-5
Deep Zone Hydraulic Conductivity Distribution

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Figure 4-6
Location of Wastewater Percolation Ponds

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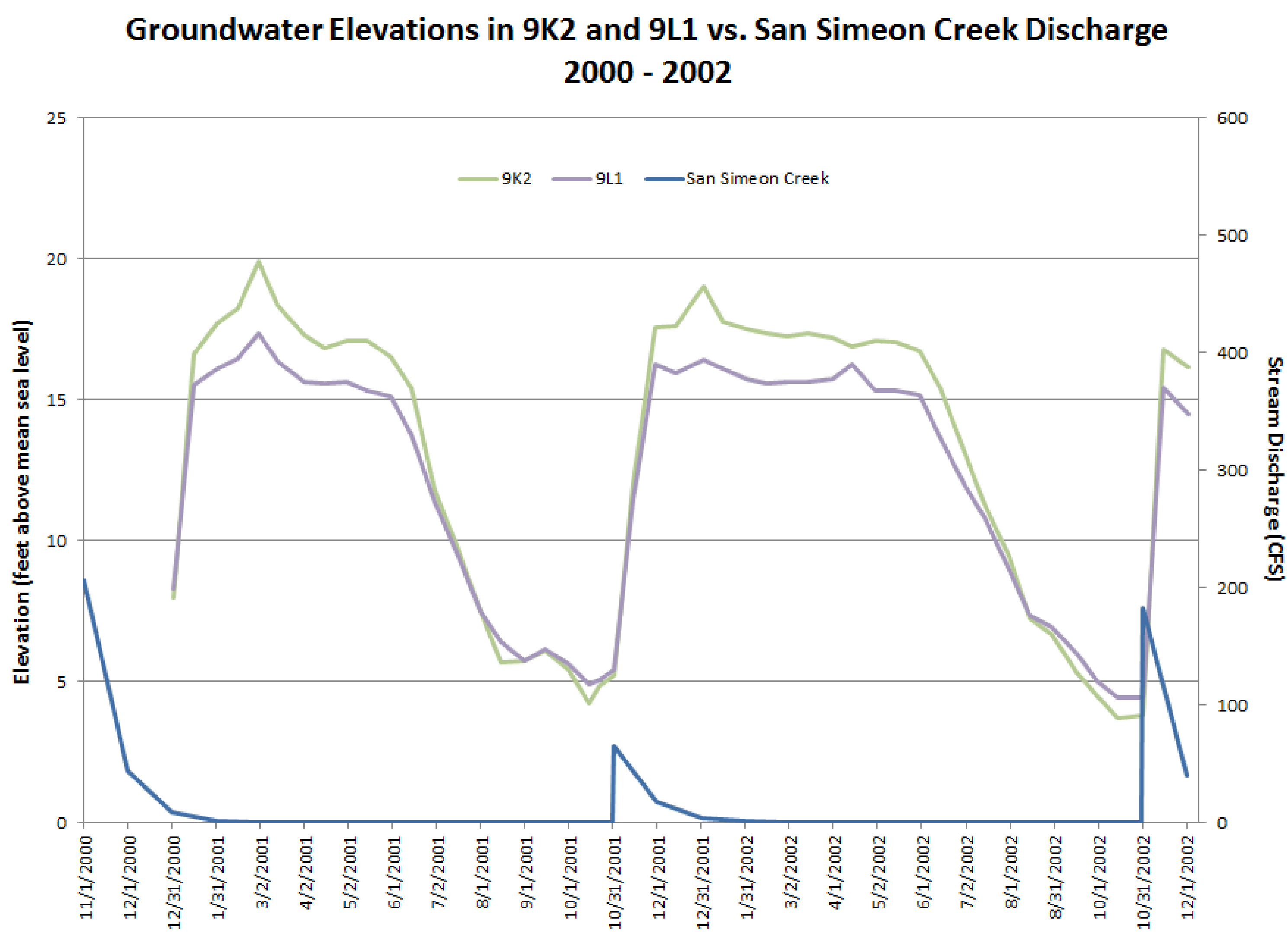

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Figure 4-7
San Simeon Creek, 9K2 and 9L1 Hydrographs

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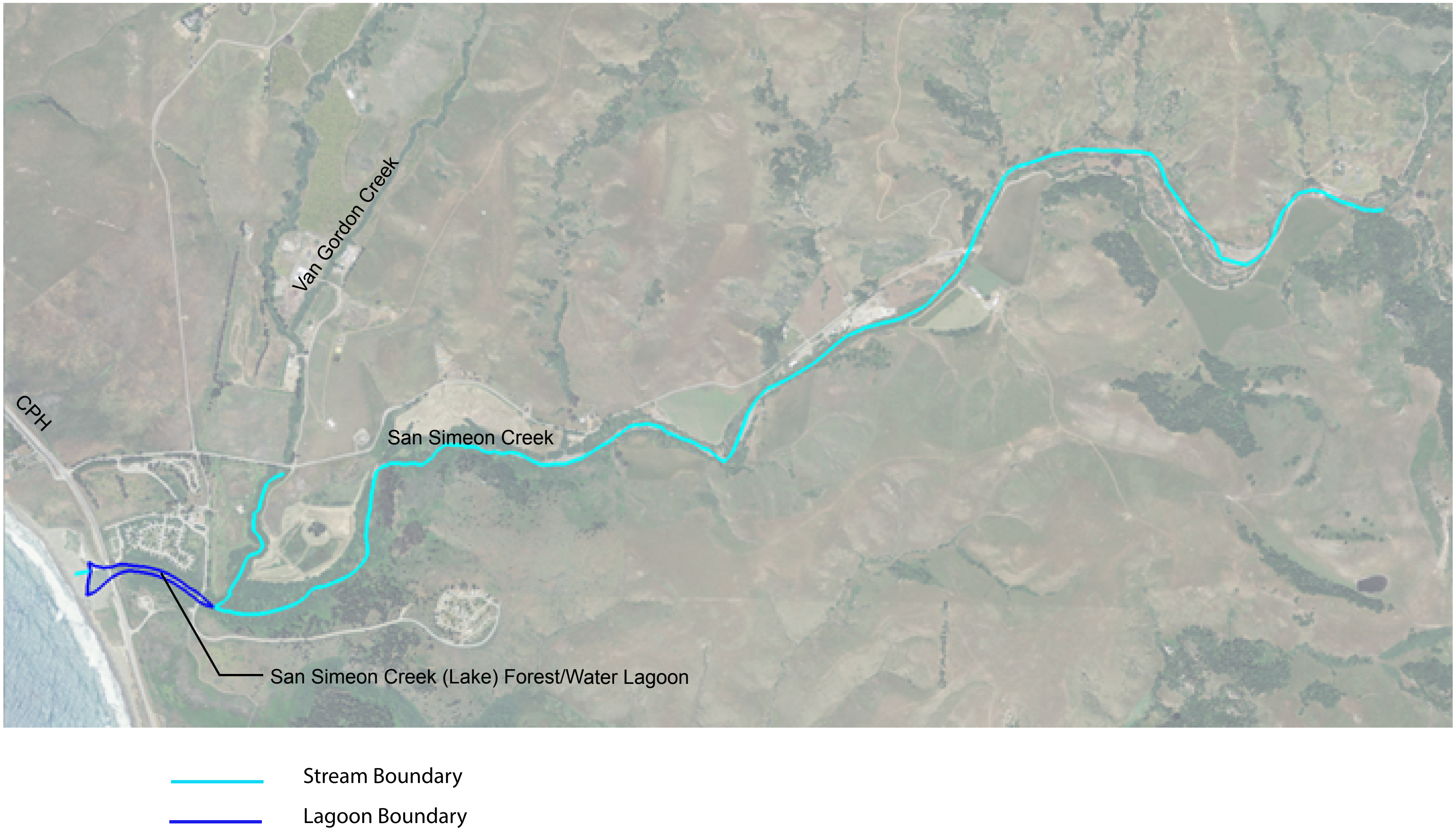

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Figure 4-8
Location of Stream and Lake Boundary Conditions

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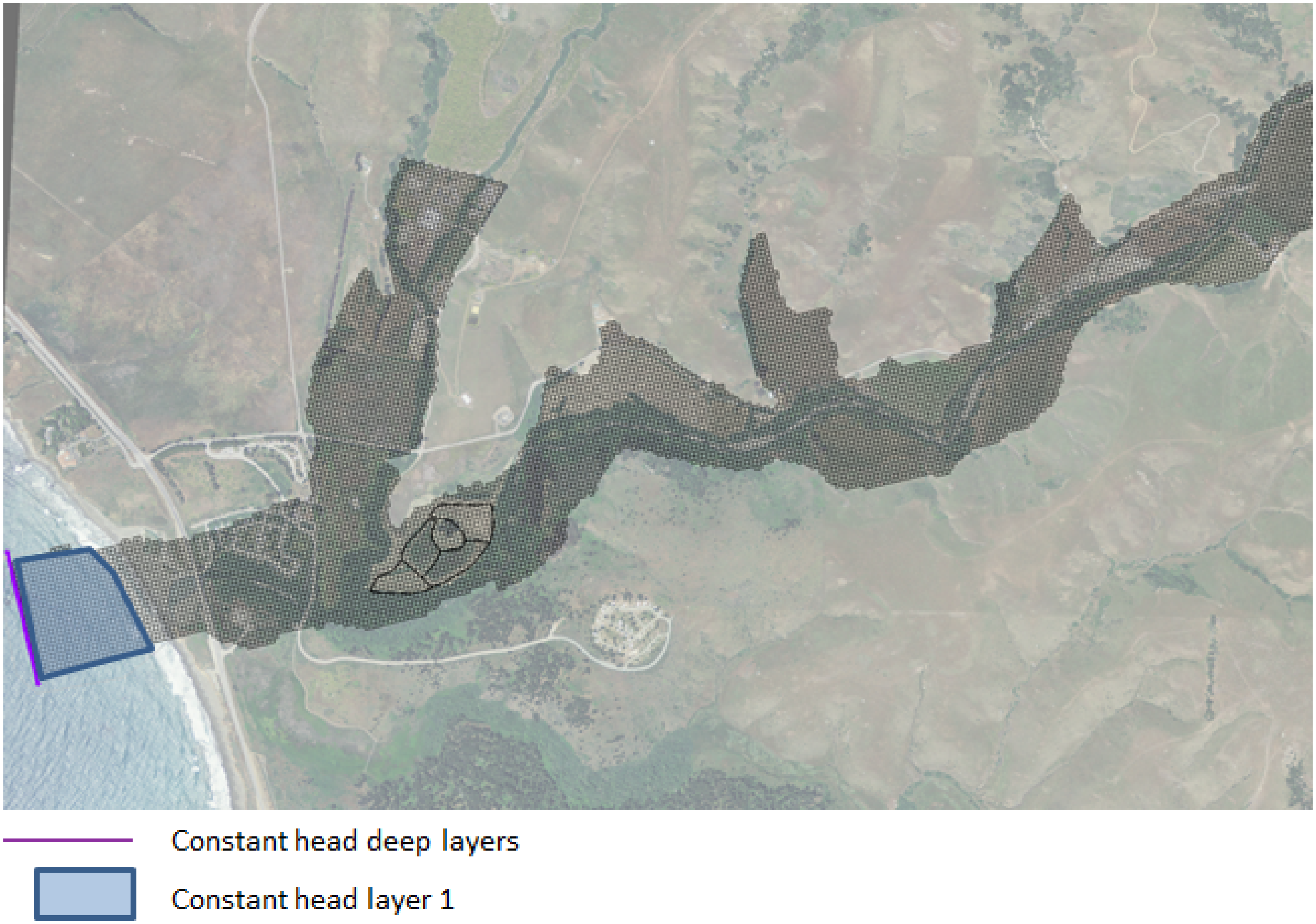

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Figure 4-9
Location of Constant Head Boundary Conditions

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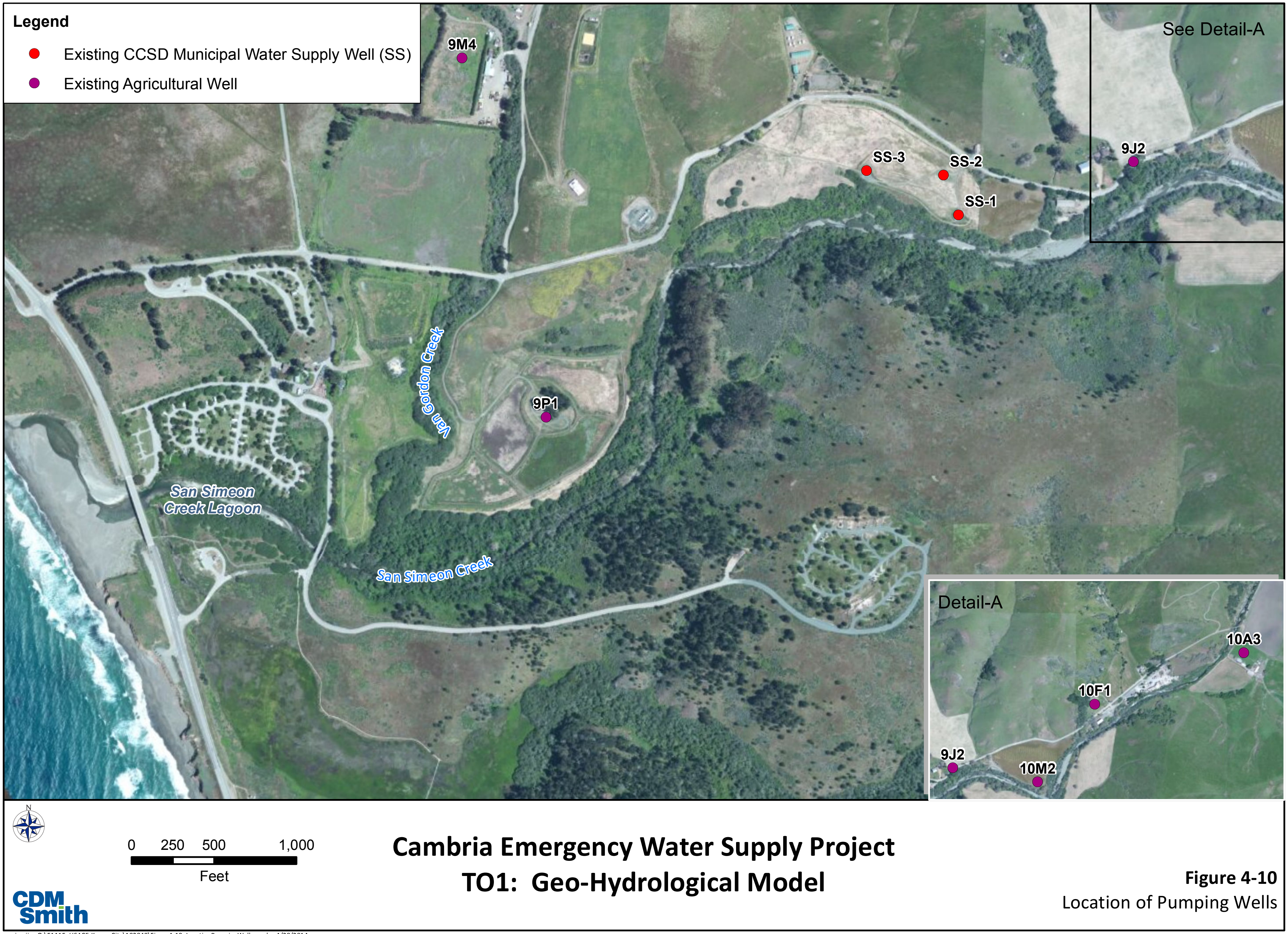

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Figure 4-10
Location of Pumping Wells

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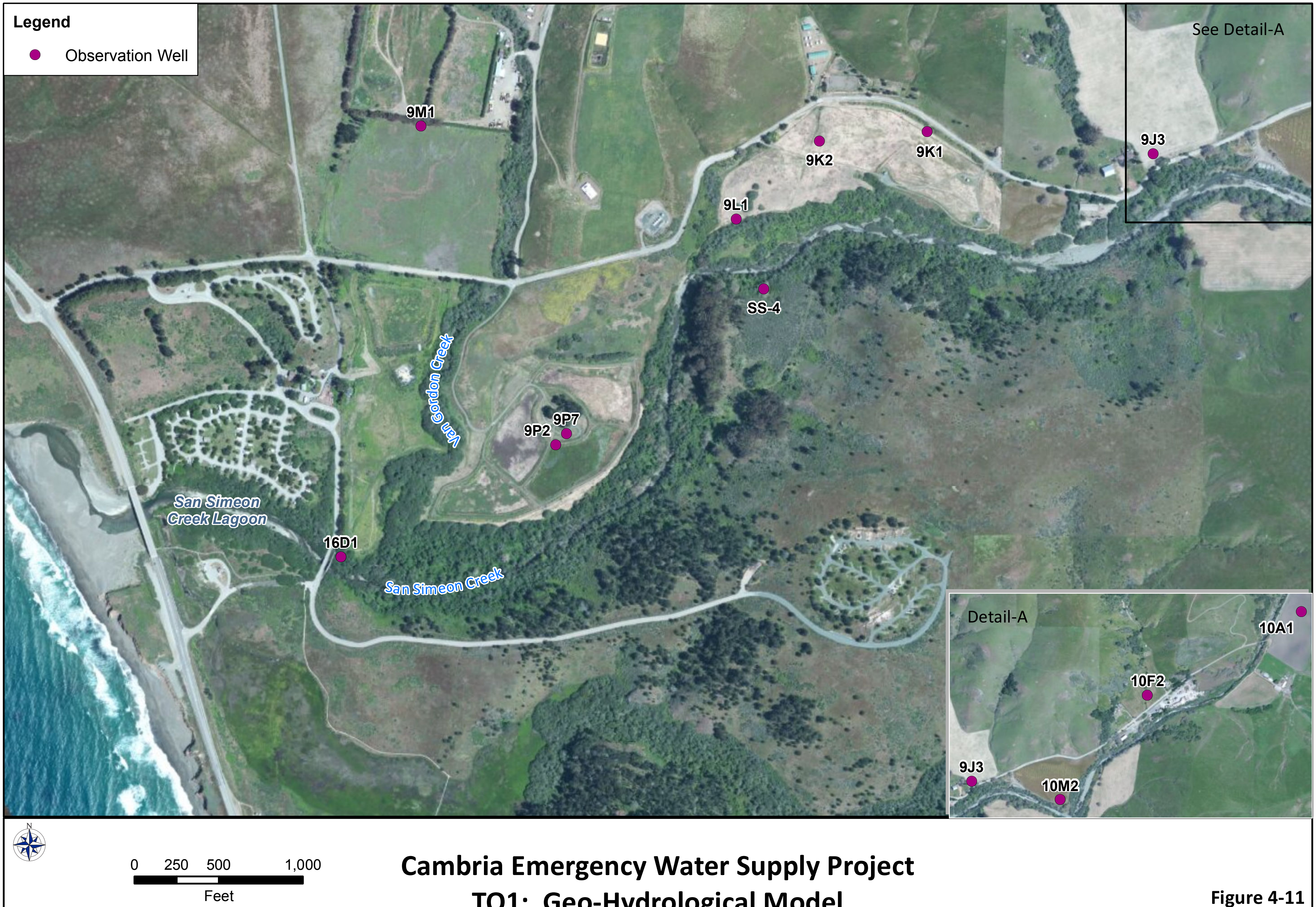

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Figure 4-11
Location of Wells with Water Level Measurements

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Section 5 Calibration

5.1 Model Calibration

A well calibrated model was developed in 2007 (Yates and Van Konynenburg, 1998) that was used as the basis for development of the current model. The groundwater flow model was calibrated by identifying sensitive characteristics with the greatest uncertainties, and varying those parameters systematically within this range of uncertainty to obtain a reasonable match between field observations and model simulated results. Hydraulic characteristics have the greatest uncertainty, since initial estimates are made at a limited number of locations, using a variety of testing methods. The initial distribution of hydraulic conductivity from the 2007 provided a reasonable match to field observations and was largely retained for this model. Additional calibration was conducted for specific yield, due to its importance for this project.

Conditions for the 2000 to 2002 period for pumping and recharge were configured from the site data and used to simulate the corresponding period. Since stream-flow occurred during 2000, prior to the formal calibration period, stable conditions prevailed in the model for the 2001 and 2002 periods that were used for the calibration. Simulations were run varying hydraulic characteristics and no significant improvement was obtained by changing hydraulic conductivity from the configuration consistent with the 2007 model.

Figure 5-1 shows a sensitivity analysis for variation of specific yield, which indicates a minimum error measure (mean of absolute value of residuals) was obtained at a specific yield of 0.16. The current model has considerably greater discretization to facilitate the transport analysis, but retains many of the characteristics of the 2007 model. A significant update included the incorporation of surveyed elevations for stream channels and the lagoon area.

5.2 Calibration results

Figure 5-2 provides an overall comparison of the final calibrated model results for corresponding field measurements. This figure plots model calculated water levels versus the field measurements for the corresponding locations and times. The 45 degree line shows a perfect agreement between the model and field measurements, while the actual scatter around this line represents the difference between modeled and measured conditions. This difference is the residual. **Figure 5-3** shows a histogram of the residuals (modeled – measured) for the calibration data set.

Several statistical measures of residuals were computed to summarize the ability of the model to represent field conditions. The mean residual value (Σ(modeled – observed)/n) was -0.48 feet, with a standard deviation of 1.72 feet. The median residual value was -0.2 feet. The range in water levels observed in the data set was from 5.4 to 57.8 feet. A standard measure of calibration is given by the RMS error/ data range, which should be less than ten percent. The RMS error in the calibration data set is 1.78, yielding a value for RMS error/data range of 3.4 percent, which meets the acceptance criteria.

Another comparison measure for the calibration is comparisons of observed water levels and modeled water levels plotted as hydrographs at individual wells. These hydrographs are available at the locations previously shown on Figure 4-11**. Figures 5-4** through **Figures 5-15** provide hydrographs from the eastern portion toward the western limit just upgradient of the fresh water lagoon.

The irrigation wells in the eastern portion of the basin typically show the greatest residuals, particularly during the later portion of 2002. This may be due to overestimation of the quantity of lateral boundary inflow or underestimation of the quantity of pumping in the upper basin. These wells are upgradient of the area of primary concern where water supply alternatives will be implemented. The area from immediately upgradient of the CCSD well field to the fresh water lagoon show very good agreement between the model and observed water levels. Limited data were available in the upper reaches of Van Gordon Creek. However, inconsistencies between estimated pumping and responses at the single well with periodic measurements indicate that a reliable calibration of this drainage is not possible. This area also has minimal interaction with the area of interest due to the lower permeability and limited groundwater flow.

The model calibration is acceptable for use in the assessment of alternatives.

5.3 Water Budget

The water budget for the model for the 2001–2002 period is summarized in **Table 5-1.** The components that are specified input values are in a bold font on this table. A negative value, (in parenthesis), indicates a net removal from the aquifer, while a positive is an inflow to the aquifer.

Table 5-1 Summary of Water Budget Components for 2001-2002 Calibration Period

Component	Annual Volume (AF)
Storage	(315)
Ocean Boundary	(251)
Recharge	**881**
Stream Seepage	806
Fresh Water Lagoon Seepage	(103)
Well Pumping	**(1015)**
Difference	2

During the calibration period, the sources of recharge, including precipitation recharge, irrigation return flows, percolation pond infiltration, lateral boundary inflow and seepage from San Simeon Creek, was 1687 AF/year. The primary outflow from the aquifer was associated with pumping for municipal and agricultural use. Outflows of groundwater to the ocean and to the fresh water lagoon were 354 AF/year, with a decrease in storage of 315 AF/year during this period.

On a long-term average basis, the change in storage is expected to be negligible, since the basin is recharged each season from stream seepage. The water budget components differ from the 1988-1989 conditions simulated in the USGS report, since many of the model inputs, including stream flow duration and pumping rates were updated.

5.4 Sensitivity Analysis

A sensitivity analysis was conducted assessing sensitivity to specific yield and to hydraulic conductivity. As noted above, specific yield was a sensitive parameter and a value of 0.16 was selected since this resulted in the minimum RMS error. A sensitivity run was also conducted to assess the impact of decreasing hydraulic conductivity throughout the model by 20 percent. This sensitivity test showed that when the hydraulic conductivity was decreased by 20 percent, the average absolute value of the residuals increased by 16 percent compared to the selected calibration values.

5.5 Model Uncertainties and Limitations

All mathematical models are simplified representations of very complex natural systems. The model is configured using a limited number of borings to assess the distributions of lithologies in the subsurface. Factors such as the lateral boundary inflow, connection with the ocean, configuration of the aquifer west of the shoreline and other factors are uncertain and have no direct field data for their characterization. The model provides a reasonable approximation of the aquifer response during calibration periods and provides a tool for assessing alternatives. The model should be refined in the future when significant changes in water use in the basin occur after implementation of the selected emergency water supply alternative to refine operational parameters.

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TO1: Geo-Hydrological Model

CDM Smith

Figure 5-1
Specific Yield Sensitivity Analysis

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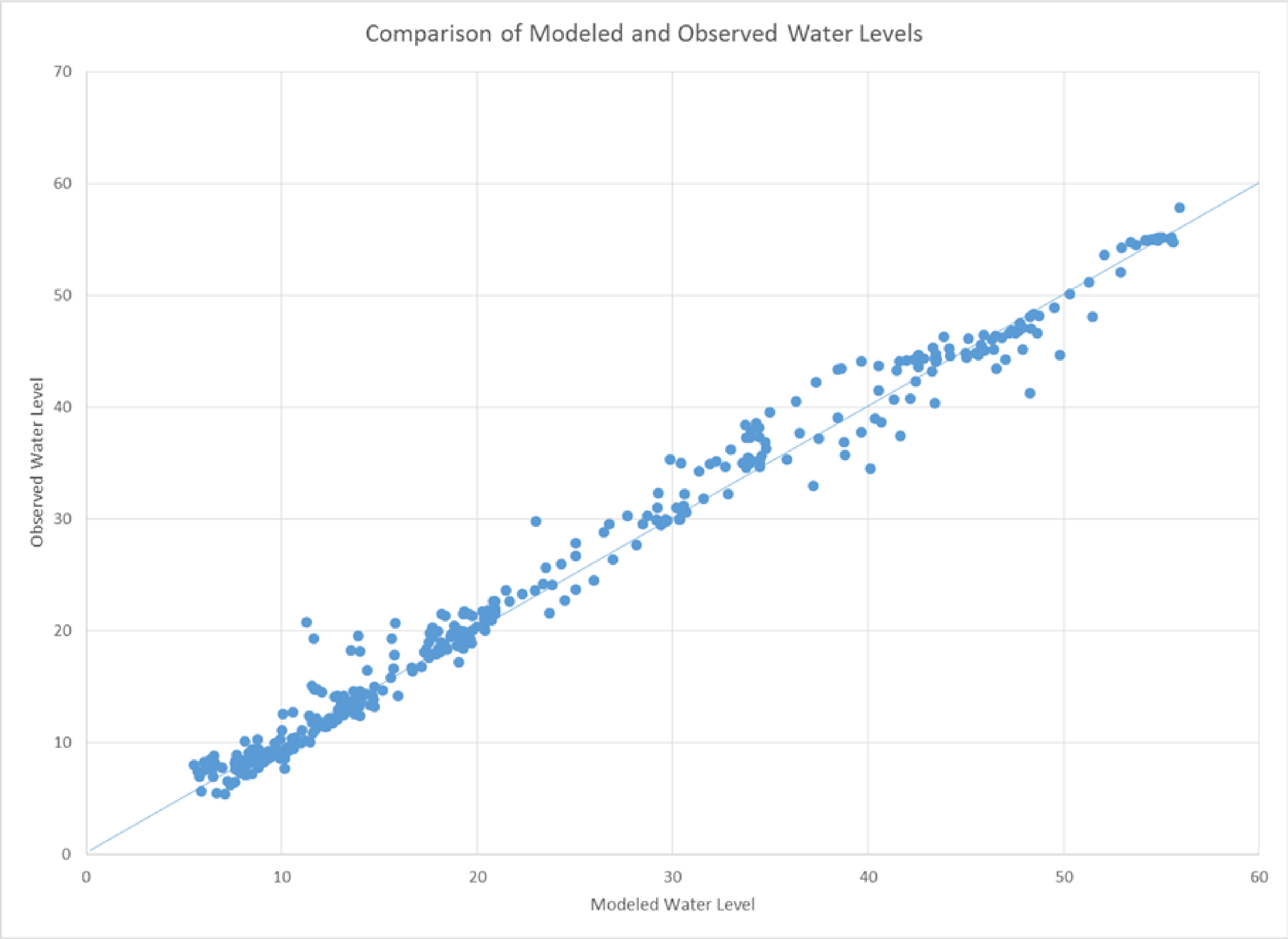

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Figure 5-2

Comparison of Modeled and Field Measured Water Levels During the 2001 to 2002 Calibration Period

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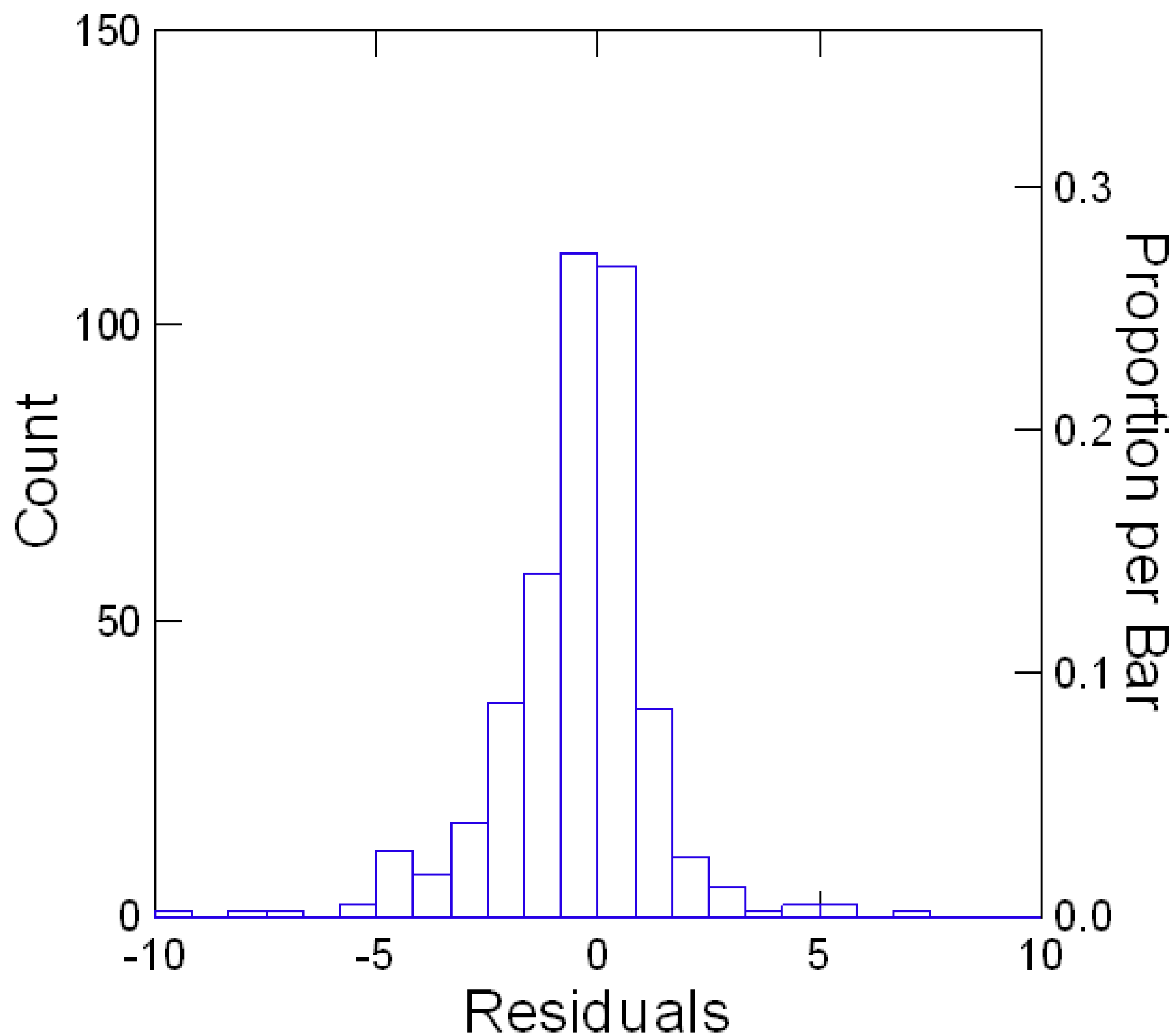

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Figure 5-3
Histogram of Model Residuals

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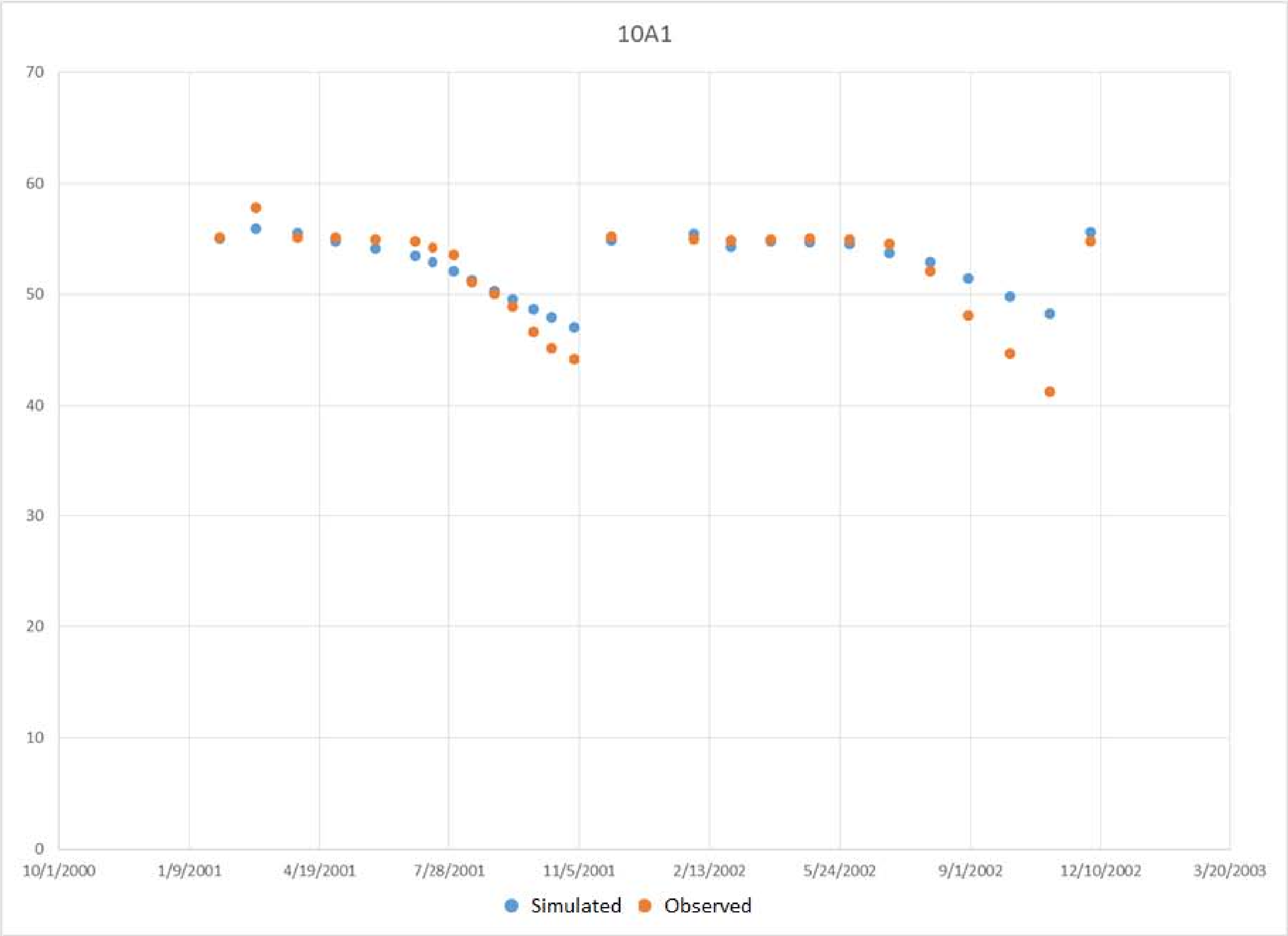

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 5-4
Observed and Modeled Hydrographs at Well 10A1

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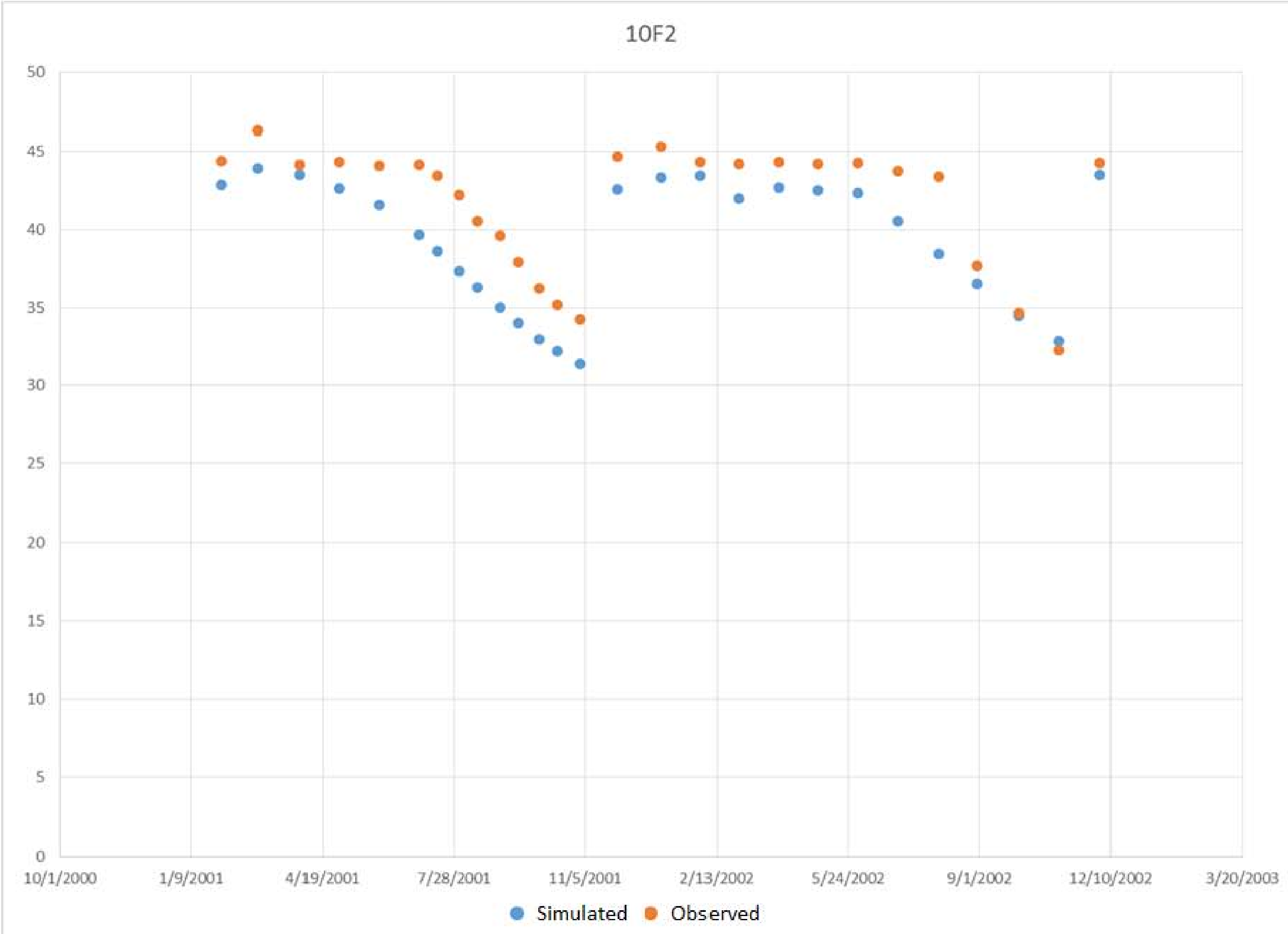

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Figure 5-5
Observed and Modeled Hydrographs at Well 10F2

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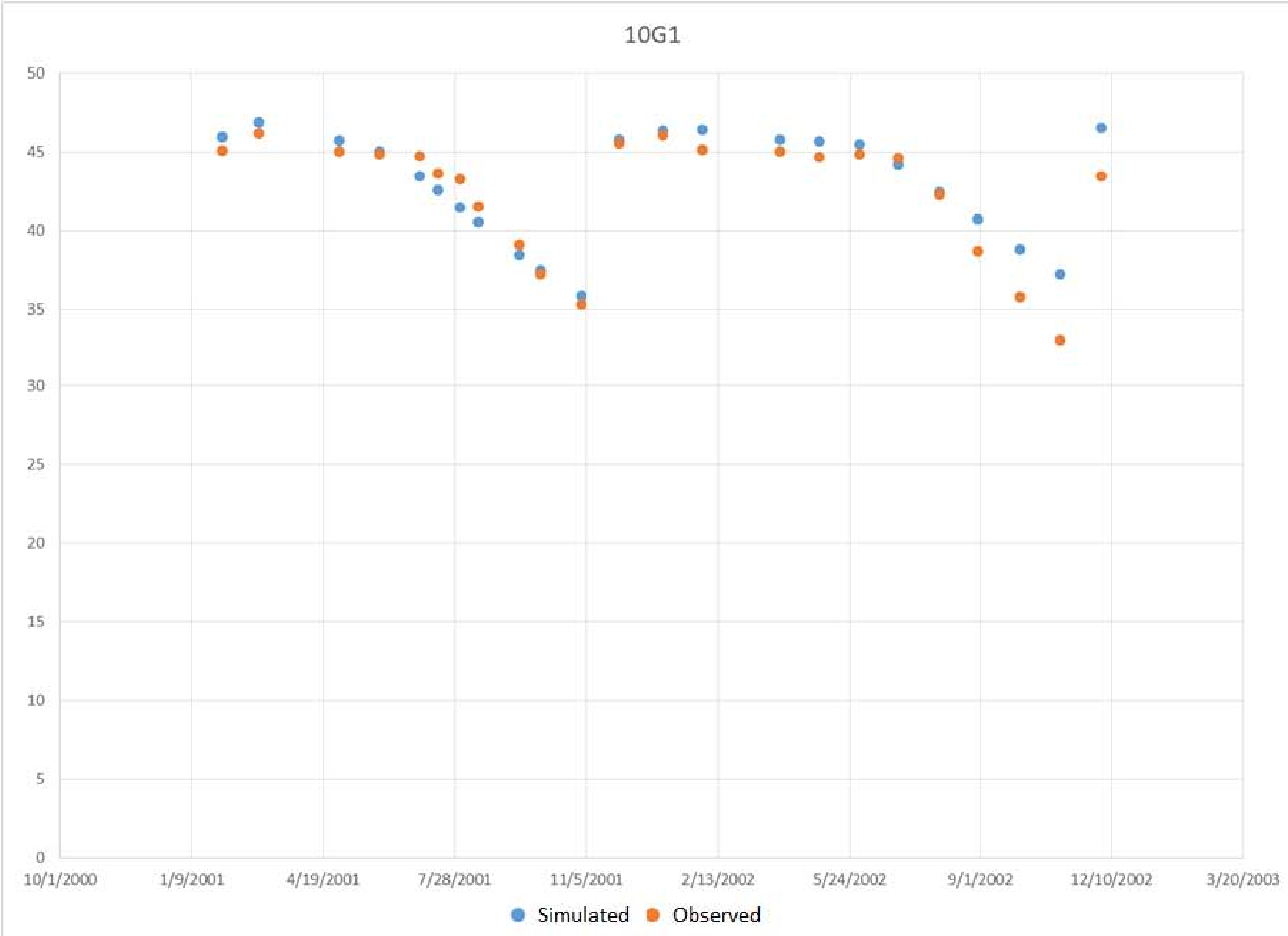

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Figure 5-6

Observed and Modeled Hydrographs at Well 10G1

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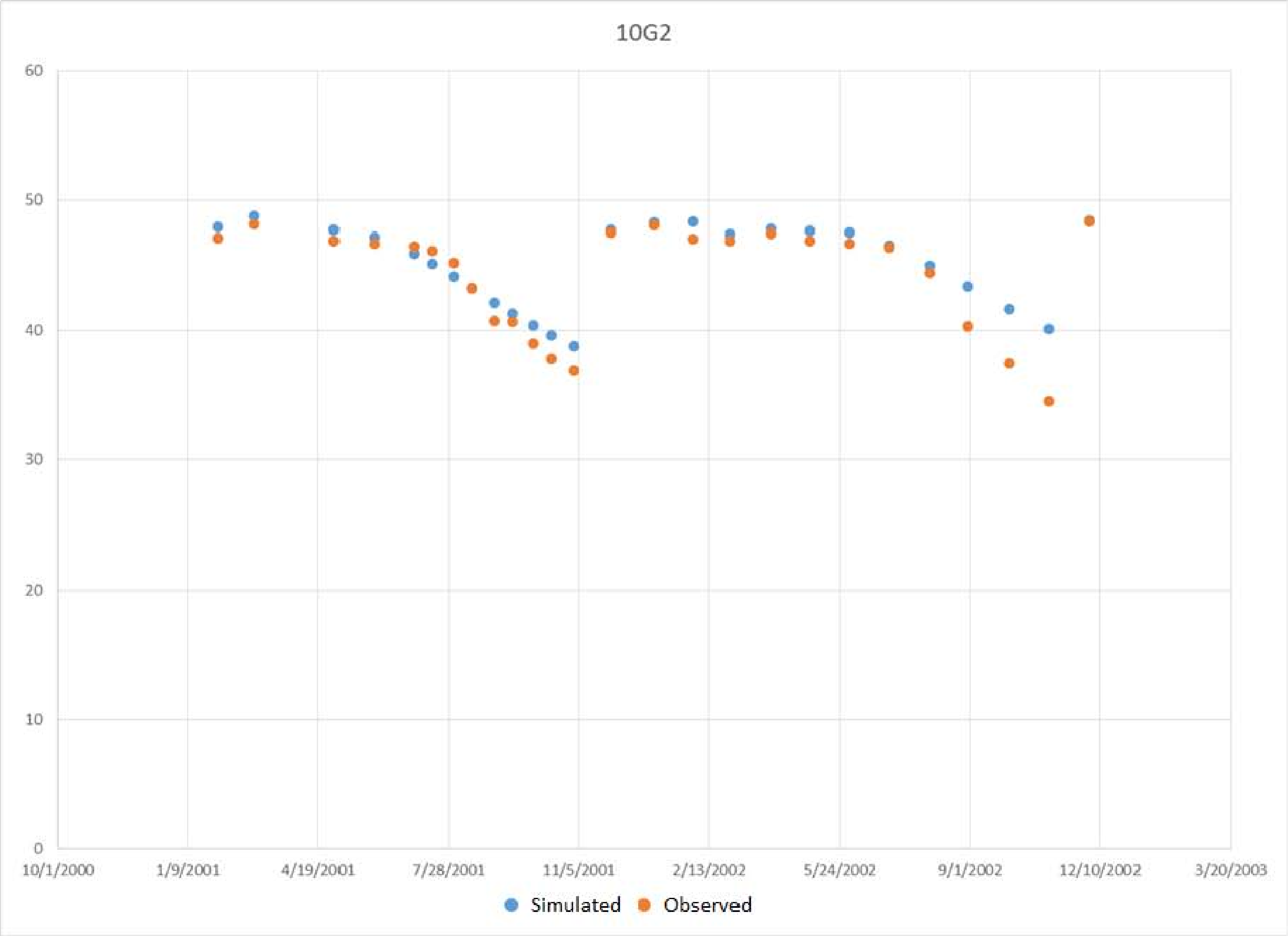

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TO1: Geo-Hydrological Model

Figure 5-7
Observed and Modeled Hydrographs at Well 10G2

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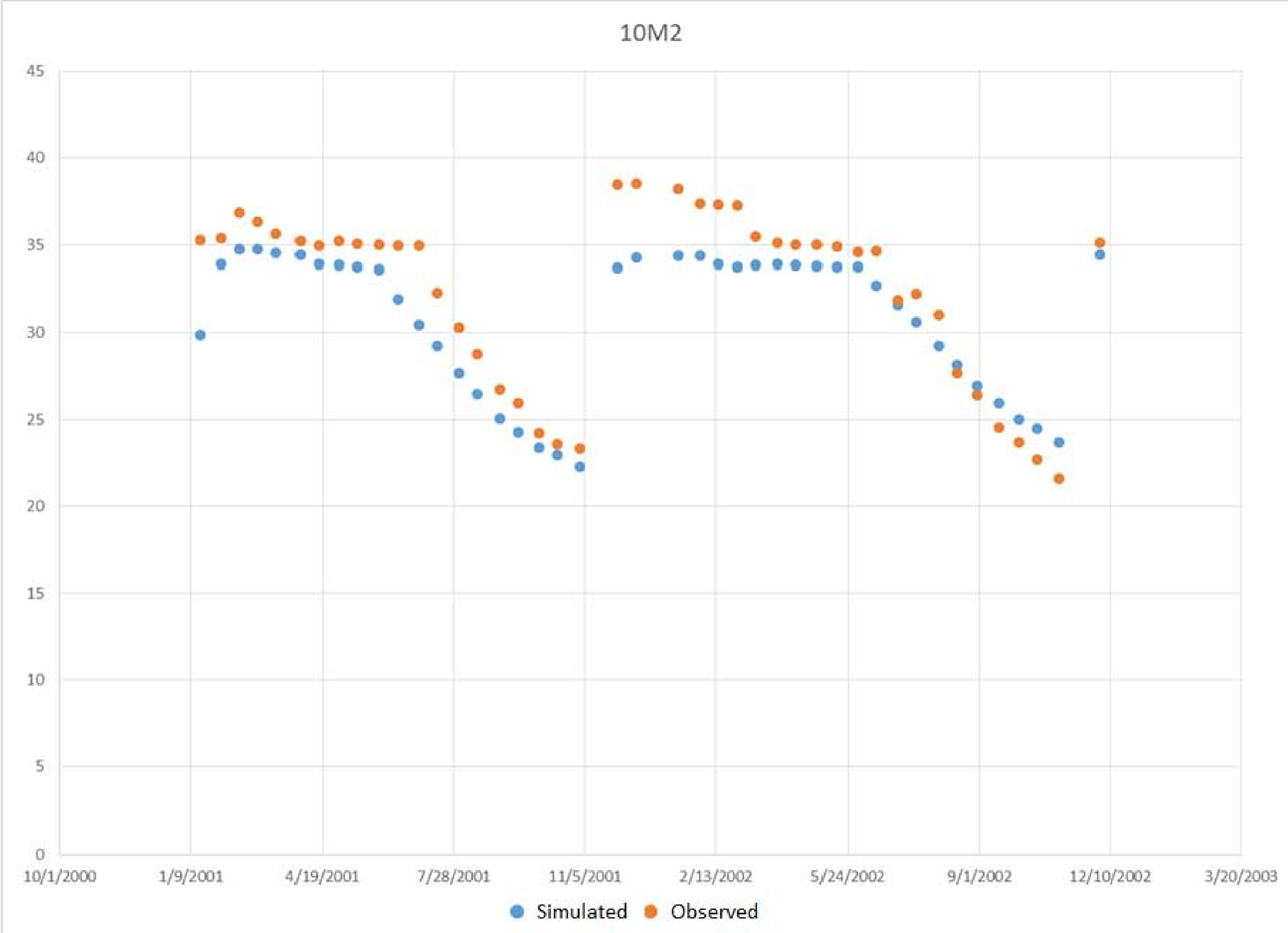

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Figure 5-8

Observed and Modeled Hydrographs at Well 10M2

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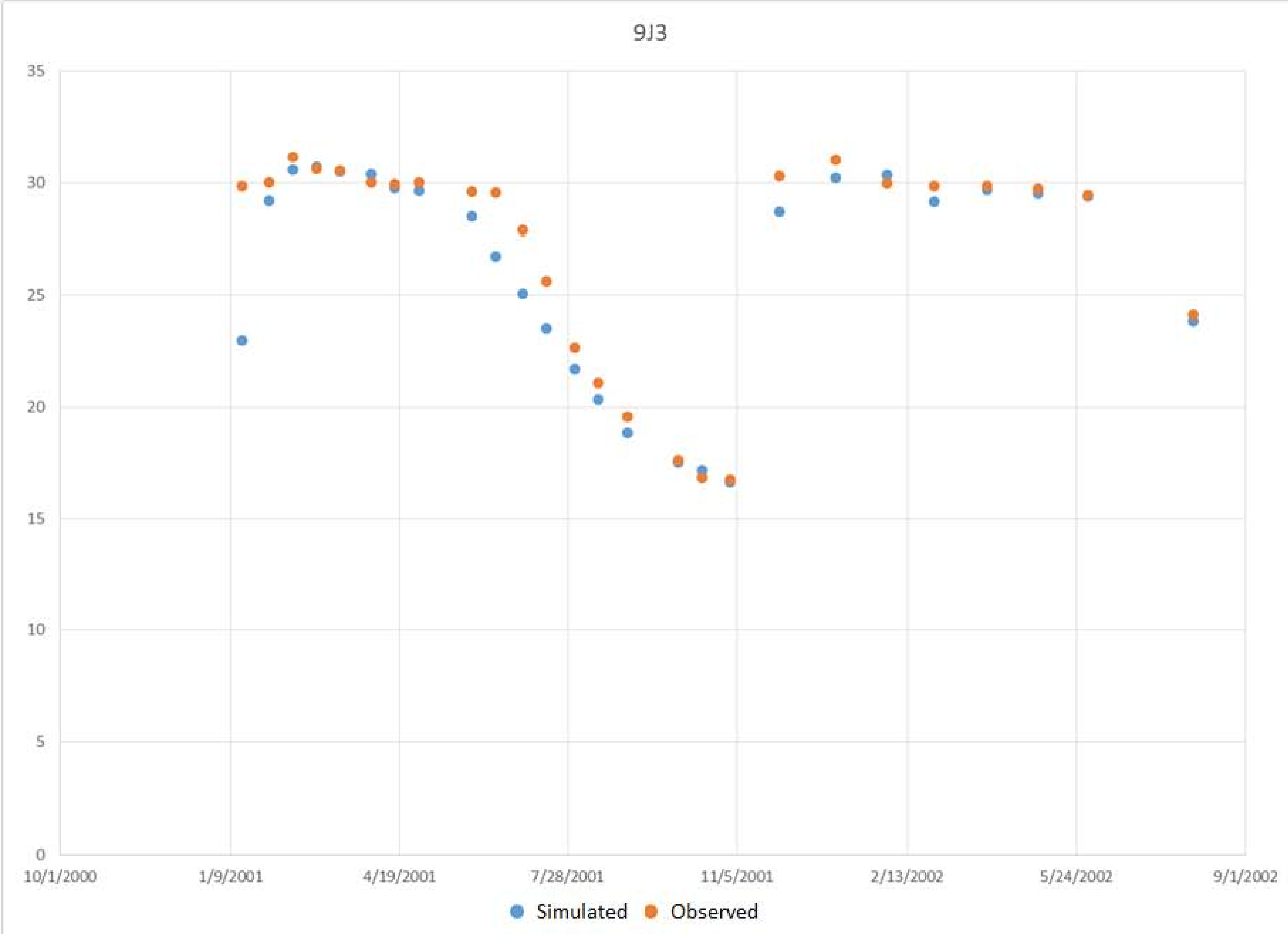

Cambria Emergency Water Supply Project

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Figure 5-9

Observed and Modeled Hydrographs at Well 9J3

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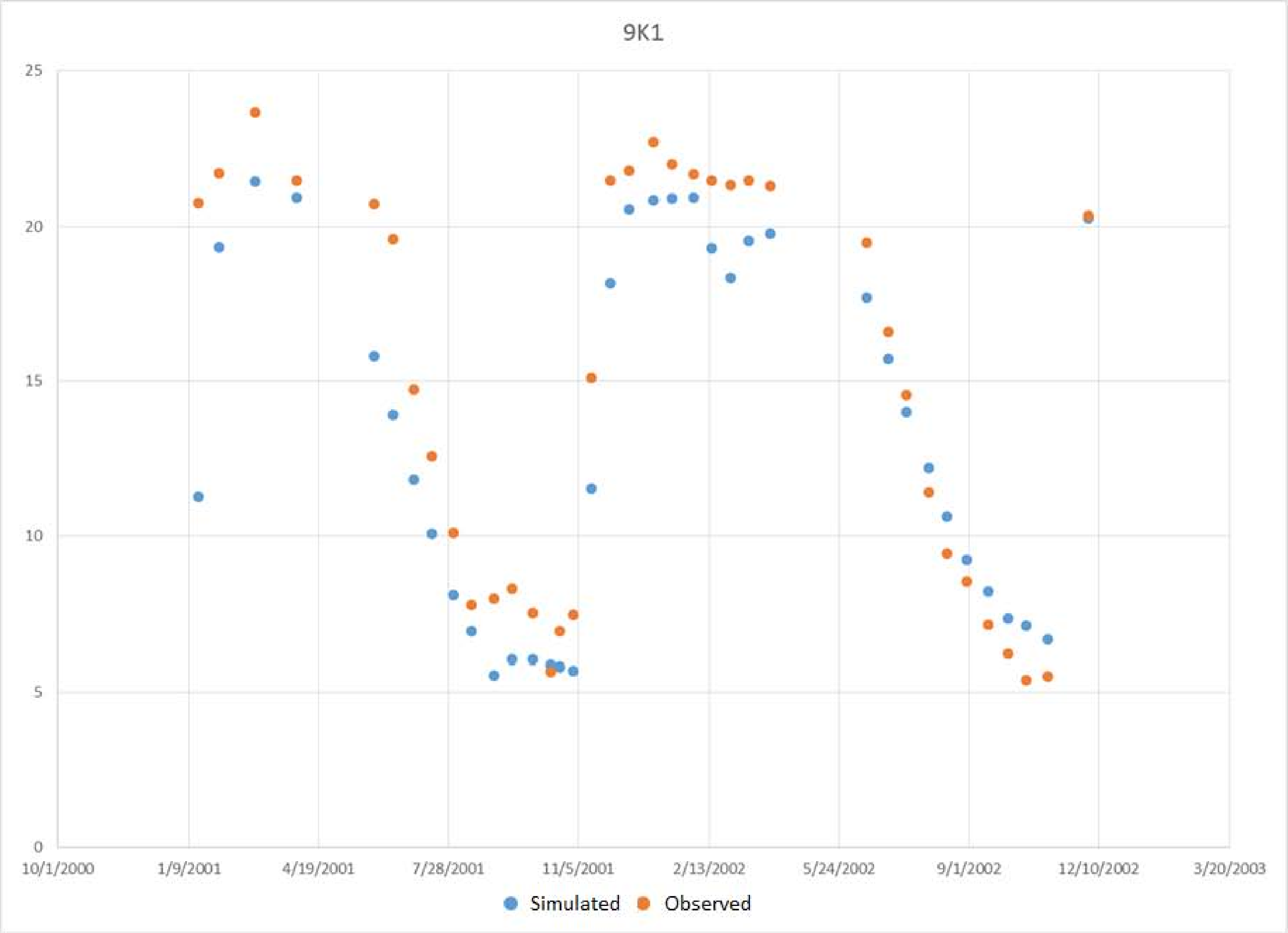

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Figure 5-10
Observed and Modeled Hydrographs at Well 9K1

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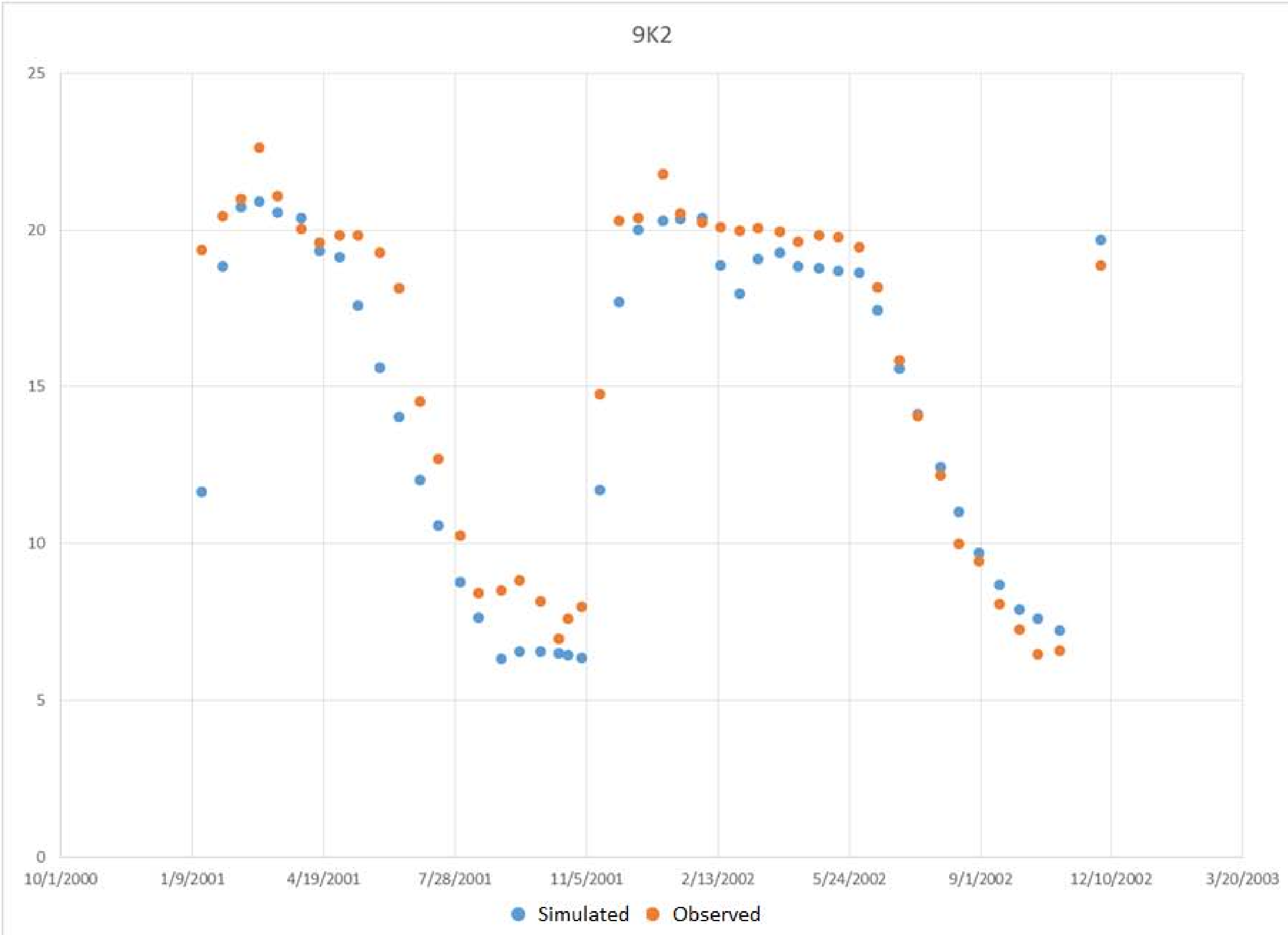

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Figure 5-11
Observed and Modeled Hydrographs at Well 9K2

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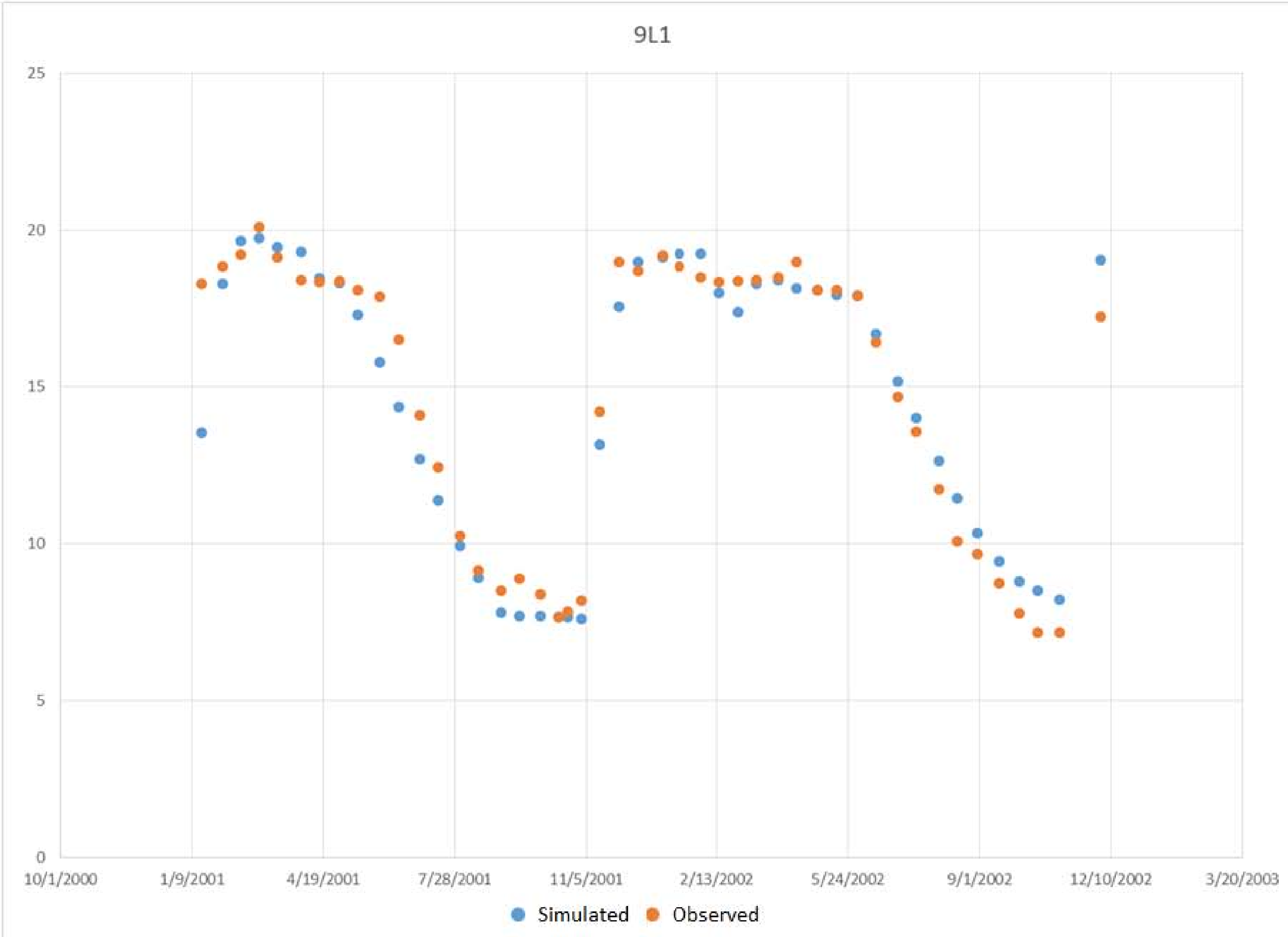
Exhibit 10.2



Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 5-12
Observed and Modeled Hydrographs at Well 9L1

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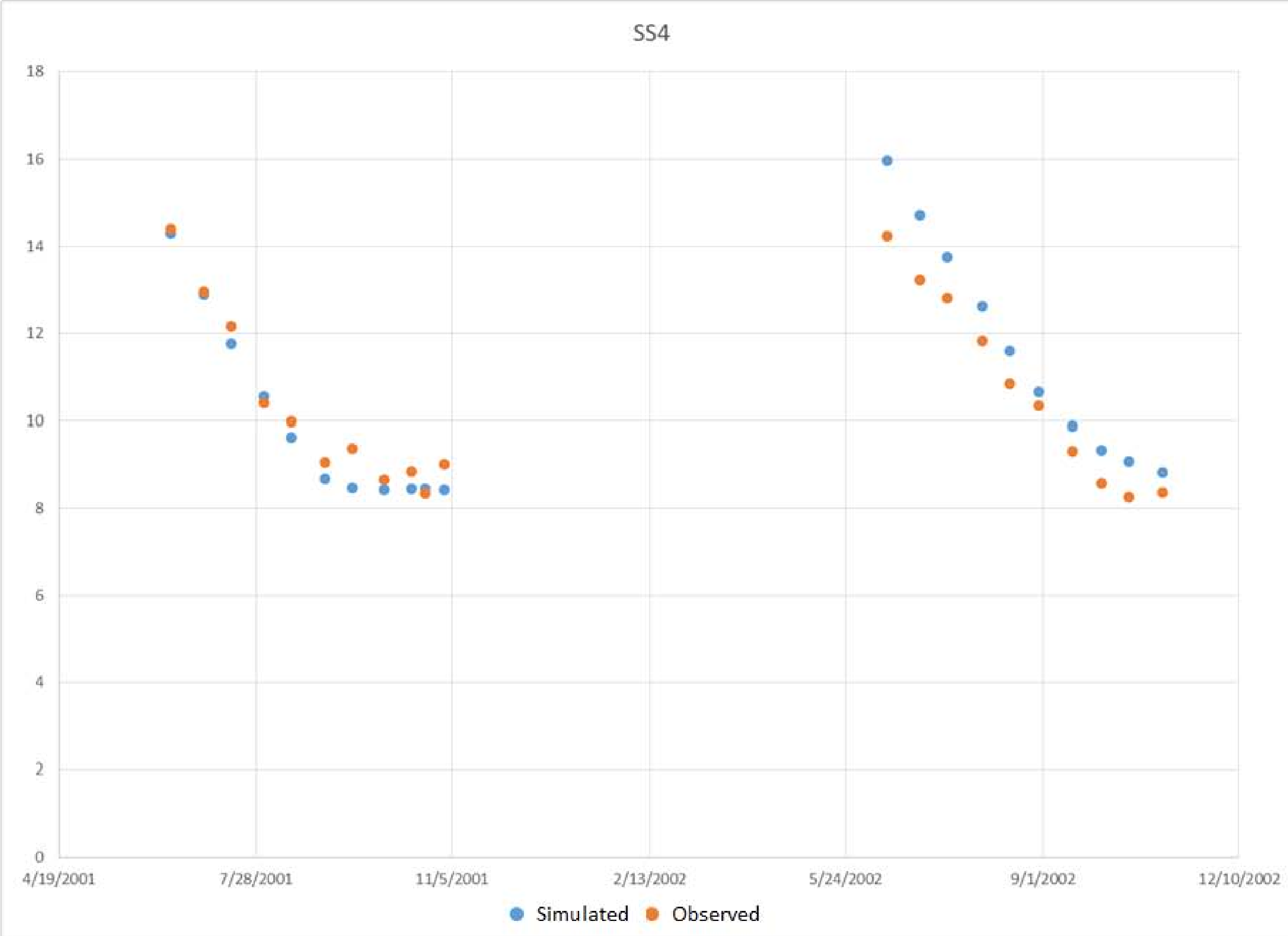
Exhibit 10.2



Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 5-13
Observed and Modeled Hydrographs at Well SS4

ramirezjj C:\Users\ramirezjj\Documents\51115 USACE\102849 Cambria\Figure 1-1_Location of Study Area with Significant Site Features.mxd 3/28/2014

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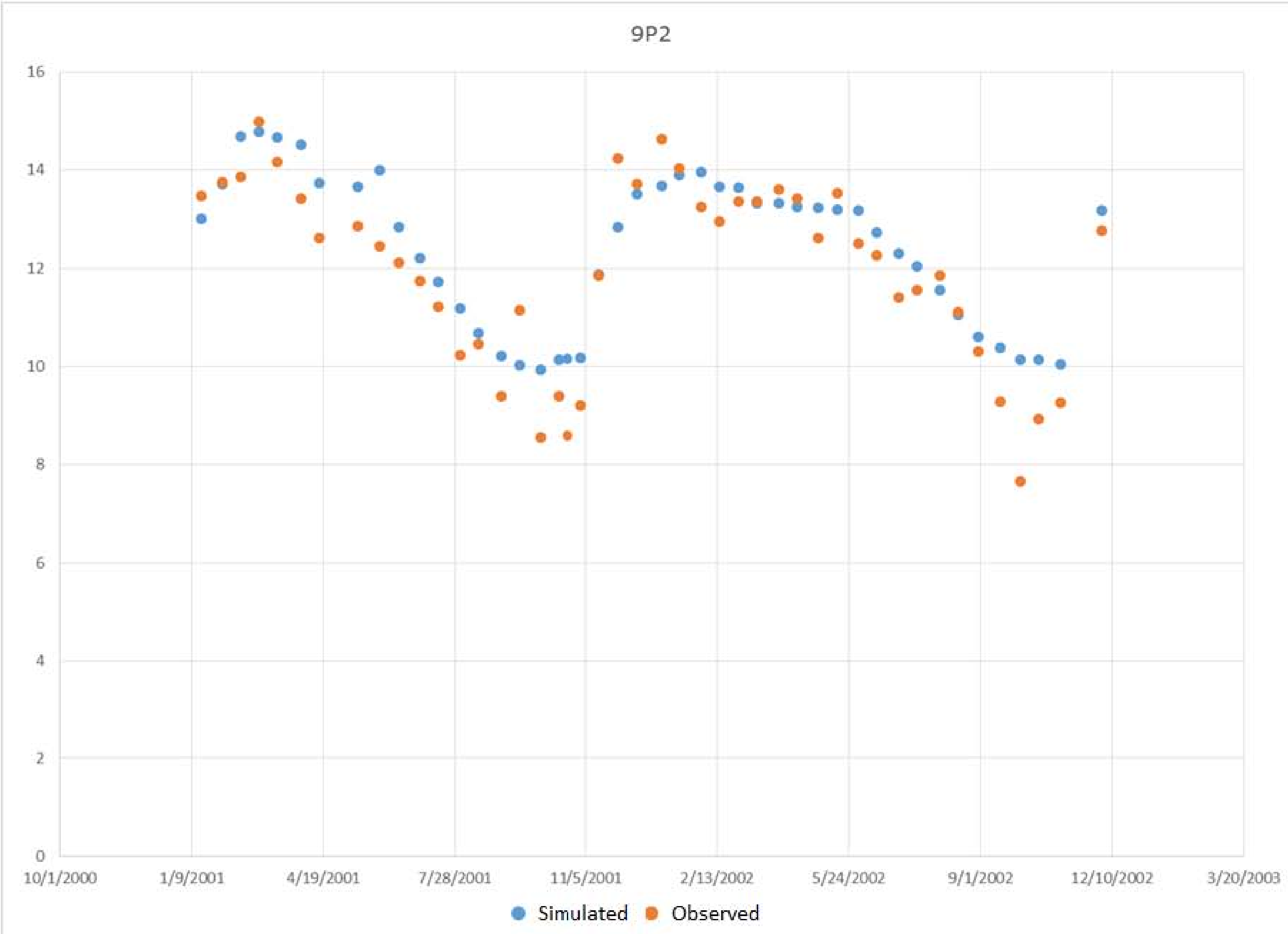

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 5-14
Observed and Modeled Hydrographs at Well 9P2

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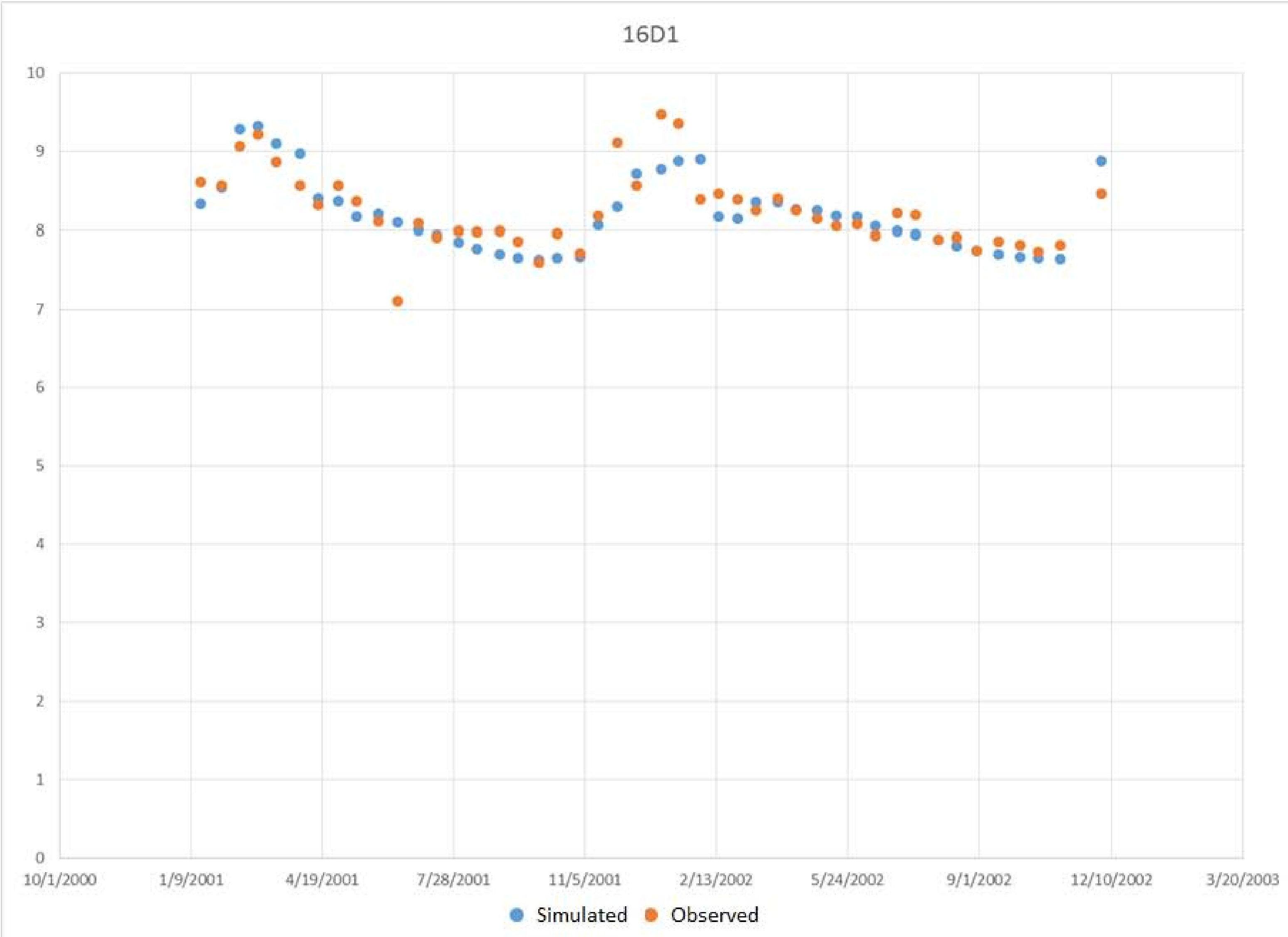

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 5-15
Observed and Modeled Hydrographs at Well 16D1

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Section 6 Alternatives Analysis

A series of alternatives were defined to address short term emergency water supply for CCSD in the San Simeon basin. These alternatives are focused on development of additional emergency water supply by optimizing recovery of fresh and brackish water in the basin. Currently, significant quantities of fresh water discharge to the ocean. The secondary treated wastewater that is percolated into the aquifer is lost to the ocean or discharges to surface water in the western portion of the basin. A series of simulations were defined to assess the ability to recover additional groundwater and meet requirements for residence time for indirect potable reuse of wastewater affected groundwater in the basin, while also providing for habitat mitigation in the fresh water lagoon.

The assumptions for basin recharge for all of the emergency supply alternatives were identical to allow comparisons to be made. The period incorporated stream flow conditions starting in December 2012 through March 2014 using records from the gaging station in the lower portion of San Simeon Creek. Agricultural pumping rates and return flows were assumed to remain at the rates estimated in the 2007 analysis (Yates, 2007), which were also used during the calibration period. Operational data from CCSD for pumping and percolation pond discharge were obtained from records for the period through February 2014. This simulation period was selected for evaluation of the emergency water supply alternatives since it represents the current drought conditions.

Each of the alternatives will also require disposal of brines from the treatment process. However, brine disposal for the emergency supply alternatives assumes brine evaporation processes from lined ponds and does not interact with the aquifer and is not simulated. Alternatives were simulated using monthly stress periods. The solute transport model tracked the fate of secondary treated waste water and highly treated injected water by simulating movement of a hypothetical tracer compound at a concentration of 100 mg/L. The extent of the tracer over time was assessed by examination of contour maps. The calculated concentrations of the hypothetical tracer at CCSD potable water supply wells was tracked in the model to assess the residence time that the highly treated water remained in the aquifer prior to recovery at the supply wells.

Two sets of emergency water supply alternatives have been considered including two direct potable supply alternatives and two indirect potable reuse alternatives. To qualify for direct potable supply, content of the percolated secondary effluent in the basin water needs to be less than five percent. Otherwise, the basin water will be considered as reclaimed wastewater requiring treatment as it is required for the indirect potable reuse.

For wells that receive recharge from injection of the highly treated basin water, a residence time estimated by modeling needs to be greater than 120 days, which is a safety factor of two over the required field verified residence time of 60 days. The alternatives are described and results of the analysis are presented in following sections. Detailed presentation of simulation results is only presented for the potentially viable alternatives.

6.1 Emergency Alternative 1 (Direct Potable Supply)

This alternative would recover water from the deep portion of the alluvial aquifer for advanced treatment and direct potable supply in the system. This alternative would require that the produced water contain less than five percent water that originated from the percolation ponds. **Figure 6-1** shows the location of the new supply well for this alternative, which would be located on CCSD owned property just east of Van Gordon Creek and in the vicinity of the existing Wells 9N2 and 9N3.

This alternative was simulated using the standard conditions by configuring a new pumping well in only the lower portion of the aquifer and pumping the new supply well at 185 gpm, which would yield 150 gpm after advanced treatment. The design concept for this alternative was to assess the potential for obtaining water from the deeper portion of the aquifer in order to minimize production of secondary treated effluent from the percolation ponds. The existing CCSD well field would be pumped at 260 gpm, for a total potable yield of 410 gpm. Shallow recharge to support the fresh water lagoon would be done by injecting 100 gpm into the shallow aquifer near the upper extent of the lagoon, resulting in a potable water supply of 310 gpm for the CCSD distribution system.

The simulation results indicate that pumping at this location would result in development of significant vertical gradients that would induce movement of the percolated secondary treated wastewater to this well. The natural gradients also indicate that past operations at the percolation ponds have likely impacted these deeper zones, thus the criteria for less than five percent wastewater content will not be met with this alternative.

Figure 6-2 illustrates the movement of percolated wastewater in the groundwater system for a hypothetical tracer injected in the percolating treated wastewater after 270 days. Since the percolation ponds have been operating for several decades, this wastewater is present through the thickness of the aquifer and insufficient isolating strata are present to prevent this downward movement. This alternative is not viable.

6.2 Emergency Alternative 2 (Direct Potable Supply)

This alternative is similar to alternative 1, with the exception that the supplemental production well is sited near the beach area on property that is not controlled by CCSD, as shown on **Figure 6-3**. This supplemental well would also have to be pumped at a higher rate, since the TDS is higher, which will decrease the recovery efficiency of the treatment system. This well would also have to meet the criteria of not producing water with more than a five percent content of the percolated waste water in order for the treated water to be directly used.

The results of this simulation also indicate that significant quantities of waste water are present throughout the aquifer, and operation of the well would induce vertical movement of groundwater from the entire thickness of the aquifer. This alternative is also not viable due to a wastewater content greater than five percent. This well location would also produce very high TDS water, which would result in a lower recovery percentage for treated water. Recent measurements at well 8R3 in the area of this alternative indicates that the groundwater has a TDS of about 5,000 mg/L, and pumping in this area would lead to an increase in TDS.

6.3 Emergency Alternative 3 (Indirect Potable Reuse)

This alternative would pump groundwater near the percolation ponds at a rate of about 500 gpm, use advanced treatment with an estimated 92 percent recovery efficiency and re-inject this water up-gradient of the existing well field. **Figure 6-4** shows the configuration of this alternative. This water would be injected down-gradient of existing irrigation wells and upstream of the CCSD well field to minimize loss of the treated water to other users.

The objective of this alternative is to provide a source of recharge for beneficial use of the secondary treated waste water that would otherwise be lost to the ocean. The simulation results indicated that travel times to the closest CCSD production well will not meet the criteria of 120 days of residence time with an injection well located down-gradient of the irrigation wells. This is due to the short distance available to avoid losses to the irrigation wells and a narrowing of the bedrock valley that result in higher groundwater velocities in this area. The criteria could be met by moving the injection well up-gradient of these irrigation wells, however, this would result in loss of injected water under drought conditions to the irrigation wells when they are pumping. This alternative is potentially viable with a move to a further up-gradient location and resolution of the potential loss of highly treated water to irrigators.

6.4 Emergency Alternative 4 (Indirect Potable Reuse)

This alternative is designed to maximize recovery of the percolated secondary treated wastewater while maintaining a mound to avoid movement of percolated waste water toward the existing well field. This alternative is summarized on **Figure 6-5**. Existing well 9P7, located within the percolation pond area, will be pumped at 710 gpm and will undergo advanced water treatment. A new injection well located between the percolation ponds and the existing CCSD well field will receive 485 gpm, while 100 gpm will be infiltrated near the fresh water lagoon to maintain its viability. Wells SS1 and SS2 would be pumped at 227 gpm each to supply CCSD demands. Well SS3 will not be operational when the basin receives the injected water from the advanced water treatment plant due to its proximity to the recharge well. This conservative assessment assumes that the emergency operations would continue for over a year, assuming that no significant runoff occurs in San Simeon Creek.

Since this alternative meets the selection criteria, detailed simulation results are presented. In order to assess the residence time, a hypothetical tracer was injected with the water at the new injection well location. The areal extent of this tracer was tracked in the model and the simulated tracer concentration in CCSD wells SS1 and SS2 summarized. **Figure 6-6** through **Figure 6-12** show a plan view extent of simulated tracer concentration greater than ten percent of the injected concentration the aquifer at 30 day intervals through 210 days of operations. These figures are a visualization through all of the model layers and represent the maximum extent of the ten percent contour in all of the layers. **Figure 6-13** shows the simulated water level after one year of operations, illustrating the mounding at the injection well with radial flow along the aquifer extent both toward the CCSD supply wells and toward the percolation ponds.

Figure 6-14 shows the simulated breakthrough curve for simulated tracer concentration at wells SS1 and SS2 under pure advective flow conditions. Based on this simulation, the estimated residence time from the injection well to well SS2 is 133 days, which exceeds the criteria time of 120 days, which include the 2 times safety factor over the regulatory target residence time of 60 days. The current draft regulations indicate that with the degree of treatment proposed, a residence time of 60 days, confirmed by a tracer study, will meet the requirements for indirect potable reuse. This alternative has the disadvantage of recirculating a significant quantity of water back to the source well at the percolation ponds where it would be repumped and retreated. Some of this recirculated water would also maintain water levels in the lower basin, which will be beneficial for habitat mitigation at the fresh water lagoon. Approximately 60 percent of the water produced at wells SS1 and SS2 would originate from the injection well during the simulated 1.25 years of operation. The breakthrough curves on Figure 6-14 indicate that half of the water produced at wells SS1 and SS2 would originate from the highly treated water recharged to the basin by between 160 and 200 days for the range of assumptions simulated. The percentage of recovery would increase for longer durations under more extreme drought conditions, as basin inflow decreases. If the emergency alternative is operated for only a period of 3 months, all of the water produced by wells SS1 and SS2 would originate from the basin, since the reinjected water would still be in transit from the recharge well, however, the mounding created at the recharge well would serve to maintain a protective westward gradient, and decrease the rate of water level decline at the production wells.

In order to assess uncertainties in the projections of residence time for this alternative, a series of sensitivity analyses were conducted. The sensitivity analyses included assessing the impact of a significant decline in basin sources of recharge, including native precipitation and lateral boundary inflow. These factors were decreased to half the value used in calibration. The effect of variations in groundwater velocity in the aquifer was assessed by adding the effect of dispersion. As noted earlier, the dispersion process accounts for uncertainties in groundwater velocity associated with small scale variations in the aquifer.

An additional sensitivity simulation decreased the effective porosity and included dispersion. This reasonable worst case simulation included a longitudinal dispersivity of 67 feet and an effective porosity of 0.14. This is a very conservative assessment. Figure 6-14 also shows the simulated tracer breakthrough curves for the base alternative and the three sensitivity simulations. The worst case simulations show that the ten percent breakthrough could occur in less than 120 days with the simulated location of the injection well. The location of the well will be moved slightly down-gradient during preliminary design so that a simulated breakthrough for the worst case simulation is beyond the criteria 120 days.

Maintaining the viability of the fresh water lagoon that is present in the lower reach of San Simeon is an important goal of the project. This viability will be maintained by infiltrating treated water in an area adjacent to the channel on CCSD property to support flow into the upper reach of the lagoon area. A preliminary estimate of 100 gpm was used as a basis to assess the potential for maintaining fresh water in the lagoon area during the drought conditions. The intention of mitigation is to avoid or minimize to the extent feasible negative impacts on the fresh water lagoon.

This fresh water lagoon support was assessed by comparing simulated water levels near the channel and fresh water injection wells to determine the extent to which this injection rate could support discharge to the channel and flow into the lagoon area. The lower extent of the lagoon near the beach has an invert elevation that is below mean sea level, so under extreme drought conditions, this lower reach will maintain a water level near mean seal level (~2.81 feet on the site datum), however, as the quantity of fresh water diminishes, the lagoon will become more saline.

Figure 6-15 shows a comparison of simulated shallow groundwater levels and the channel invert, which indicates that some discharge to the channel will occur for up to a year after commencement of the alternative. This plot assumes that alternative operations would start in late summer 2014. The quantity of water actually entering the channel will diminish over time as the drawdown in the shallow aquifer increases due to the drought and continued pumping of the basin. The rate of decline in water levels increases when irrigation pumping starts around day 300. The permeability of the lagoon deposits is unknown, so it may be necessary to provide increased discharge to the wells or directly to the channel if the drought persists for an extended period. If additional mitigation flow are required, then additional pumping from well 9P7 would be required.

The impact of the emergency operations on movement of brackish water inland from the ocean was assessed using the flow and transport model. A water balance from the simulation is shown on

Figure 6-16, which indicates that a small net discharge to the ocean will occur during the initial year of operations of the emergency alternative as storage is depleting in the basin. This figure also presents the net storage decline in the basin, since pumping will exceed the sources of recharge to the basin. The negative values for ocean outflow indicate a net discharge to the ocean, while the positive rates at month 12 of emergency operations indicate a reversal of flow and inducing a net inflow to the basin from the ocean. Depletions from storage occur through the simulated operating period.

Recent sampling of wells at the site indicated that the total dissolved solids (TDS) in groundwater have been elevated due to probable limited salt water intrusion. The secondary treated wastewater has helped to attenuate the increased TDS of the basin water. A profile of specific conductance was run at well 9P7 at the percolation ponds that indicated a TDS indicative of the treated waste water in the upper 25 feet of the aquifer, with deeper zones indicating possible impacts from limited saltwater intrusion. **Figure 6-17** shows a profile of TDS (primarily estimated based on specific conductance) extending from the beach area to the CCSD well field. A well cluster (9N2/9N3) did not indicate vertical differences in TDS. The values ranged from about 5000 mg/L at well 8R3 near the beach, to a range of 350 to 540 mg/L from the CCSD supply wells. The vertical profile data at 8R3 suggested that the well had been impacted by salt water in the past, either from flow within the aquifer or surface flooding, since the interval below the screen openings showed a TDS of about 23,500 mg/L.

Simulation of the effects of variable density was conducted using the SEAWAT model for this alternative, including the impacts of lower basin recharge, in order to validate the primary simulations using MODFLOW and MT3DMS. These simulations confirmed simulation results that were obtained using the equivalent fresh water head approach. The variable density model did show stratification of high TDS water near the base of the aquifer, however, for the 1.25 year simulated duration of emergency operations, the high TDS water did not migrate inland by a significant distance, and the closest wells near the percolation ponds are not impacted.

The simulations of TDS during operation of the emergency supply alternative was assessed using the equivalent fresh water head approach, since the more compute intensive variable density simulations indicated that this process was not required for the duration of the emergency water supply simulations. The ocean boundary was defined for the simulations as an equivalent fresh water head for each of the zones. Since the density of salt water is higher than for fresh water, as the height of the water column increases, the pressure at depth will be higher in salt water than in fresh water. The current distribution of concentrations of TDS in the aquifer was configured in MT3DMS and the emergency alternative was simulated to assess the water quality that would be produced at well 9P7, which is used as the supply well for the advanced treatment system. This provides a reasonable assessment of water quality since a net outflow to the ocean occurs through most of the simulation period. In order to develop a reasonable estimate of the impact of flow reversals from the ocean toward the 9P7 brackish extraction well, a constant concentration boundary was configured in the model between wells 8R3 and 9N2, with a concentration of 3,000 mg/L, which represents an average between these wells. The current observed data represents a long term average condition during a period when little recharge to the aquifer occurred.

Figure 6-18 shows the simulated TDS concentration at the brackish extraction well 9P7 for the emergency alternative. The simulated TDS at the start is about 800 mg/L, similar to what is observed in the percolated secondary treated wastewater. Over time, the concentration drops, since the capture zone of 9P7 includes up-gradient areas that have groundwater not impacted by either wastewater percolation and eventually recharge water that was injected at RIW1, which has a very low TDS (simulated at 100 mg/L). Flow is induced up-gradient from the west off the ocean. However the higher TDS water that is in this area does not reach 9P7 over the 1.25 year duration of the assumed emergency operations. If emergency operations were to continue into the future with no runoff in San Simeon Creek, then this higher TDS water and eventually sea water would be induced to the area of 9P7. If this extreme drought condition were to occur, the steady-state TDS would be a blend of the percolated waste water, return flows from injection at RIW1 and sea water, with minor basin flow from up-gradient after several years. Under this extreme condition, the TDS could rise as high as 8,500 mg/L when this equilibrium is reached after several years of no stream flow recharging the system.

Based on the simulations, the planned TDS should include a safety factor for design and use a design value of 1200 mg/L to account for uncertainties. If the drought extends into 2017 with no stream flow, then the TDS values will increase, potentially resulting in decreased recovery efficiency from the treatment system.

6.5 Emergency Alternative Recommendation

Based on the modeling simulations emergency water supply Alternative 4 is feasible, though there is significant recirculation of the highly treated water. Alternative 3, with a modification to the location of the injection well further up-gradient is also feasible. However, this would require access to property not owned by CCSD.

A key element of this feasibility is the use of an injection well between the CCSD well field and the percolation ponds. Use of this approach allows maintenance of a gradient that protects the well field from impacts from the percolated effluent and brackish water present in the lower basin. Emergency water supply Alternative 4 increases sustainability of the water supply under the current drought conditions, since the previously lost percolated effluent is captured, highly treated, and produced for water supply after appropriate residence time in the aquifer. The brackish water that is pumped from the basin for treatment will be diluted with percolated secondary effluent and a portion of highly treated water that is injected will maintain a protective gradient between the percolation ponds and the potable water well field.

Use of the injection well to create a mound near the freshwater lagoon has limited benefits later in the season as basin water levels are drawn down below the channel invert, precluding discharge of the mounded groundwater to the lagoon. Mitigation would be more effective by discharging the treated water directly in the open channel.

6.7 Conclusions

The modeling analysis indicates that enhancing water supplies for both emergency and long-term conditions is feasible in the San Simeon Creek Basin.

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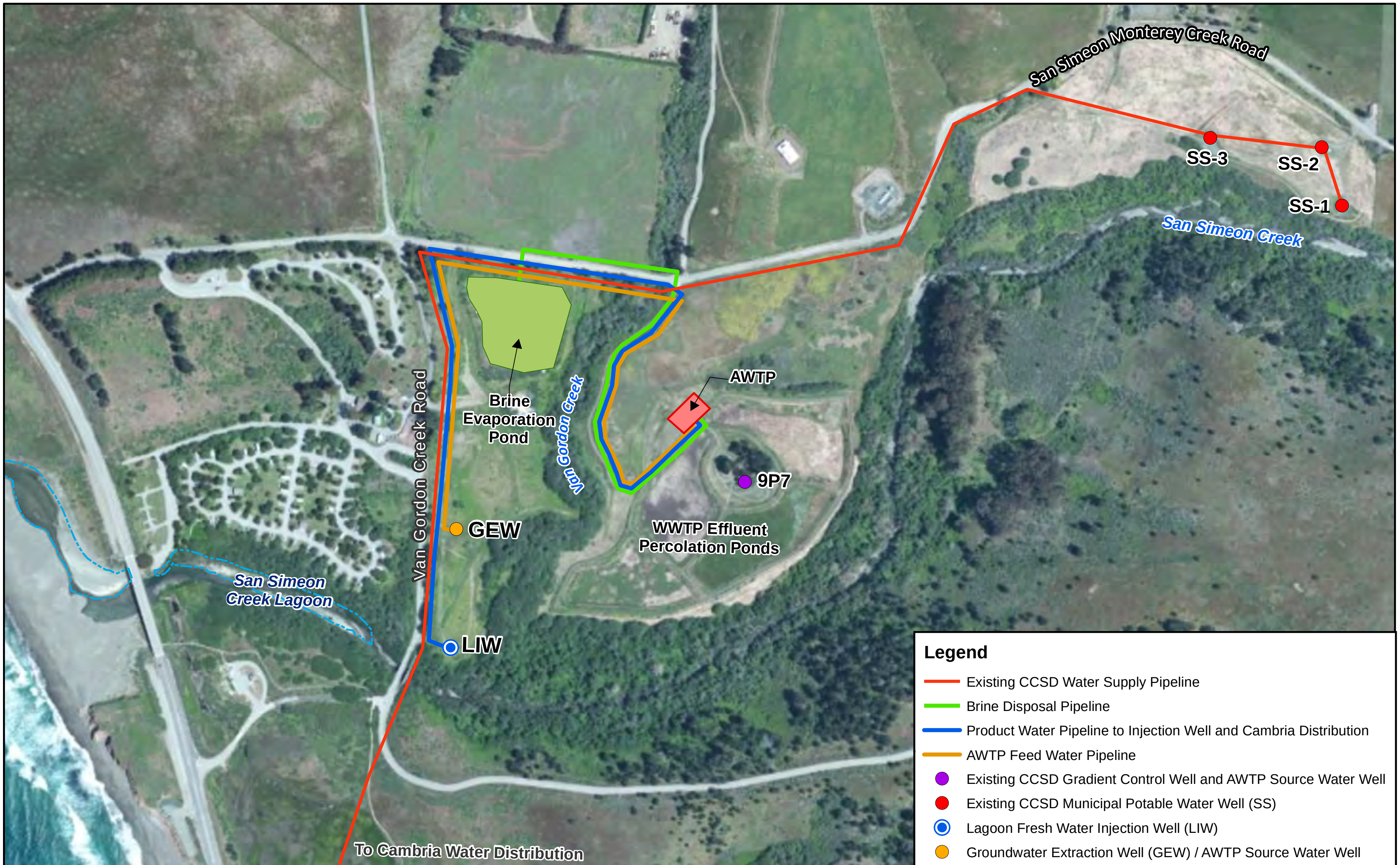

CDM Smith

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 6-1
Emergency Alternative 1 Summary

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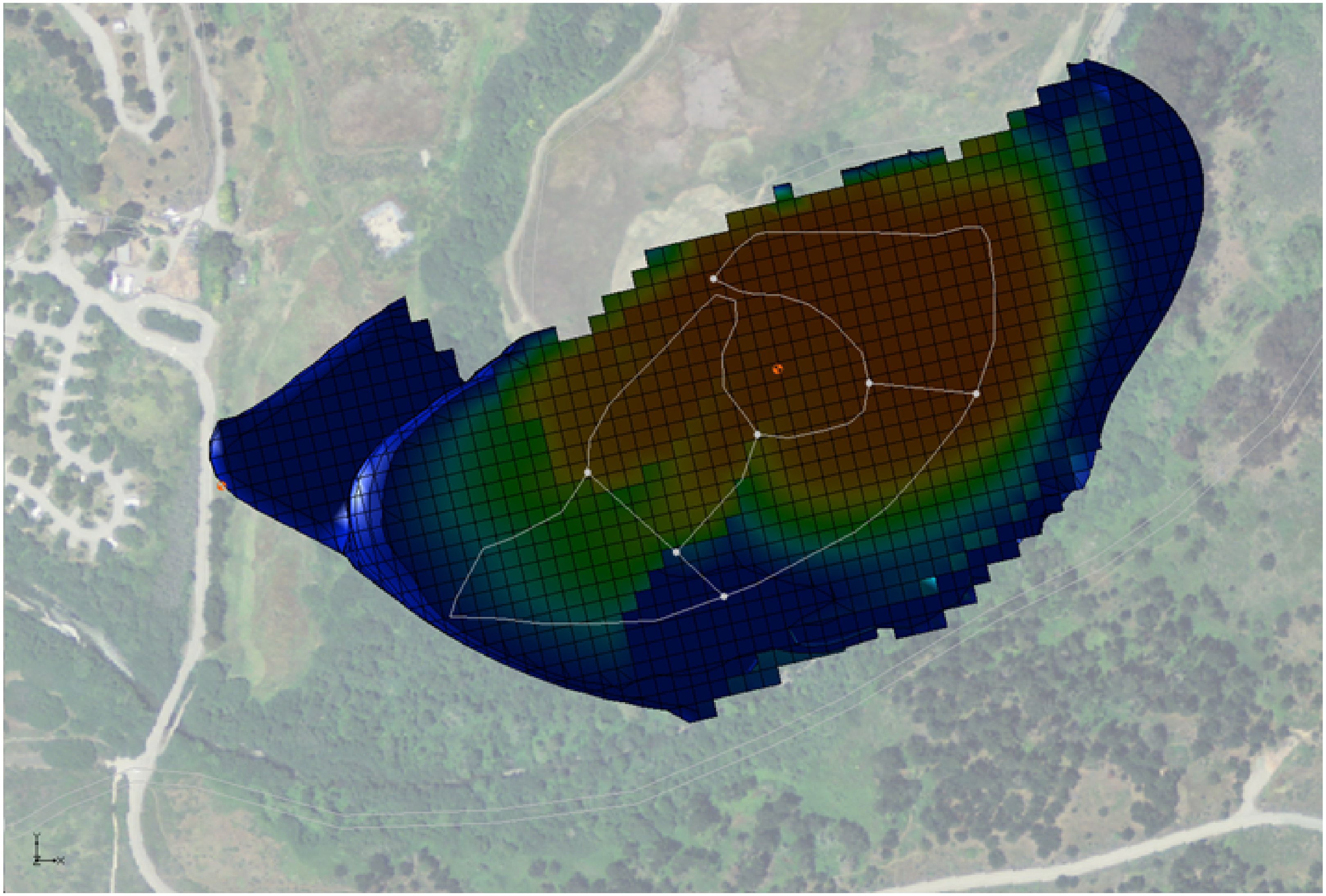

Cambria Emergency Water Supply Project

TO1: Geo-Hydrological Model

Figure 6-2

Alternative 1: Simulated Extent of Treated Wastewater after 270 days of operation Emergency

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TO1: Geo-Hydrological Model

Figure 6-3
Emergency Alternative 2 Summary

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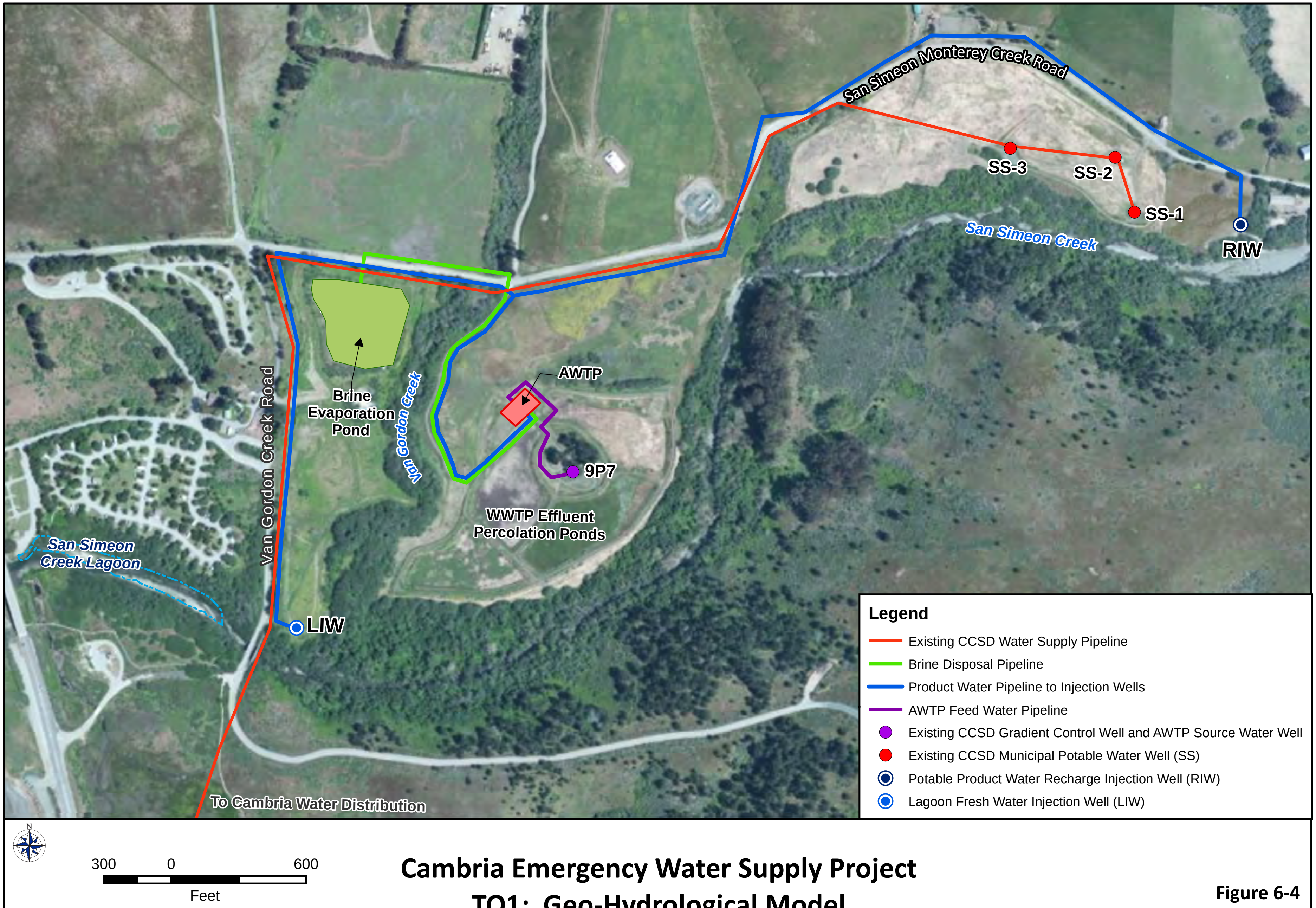

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Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 6-4
Emergency Alternative 3 Summary

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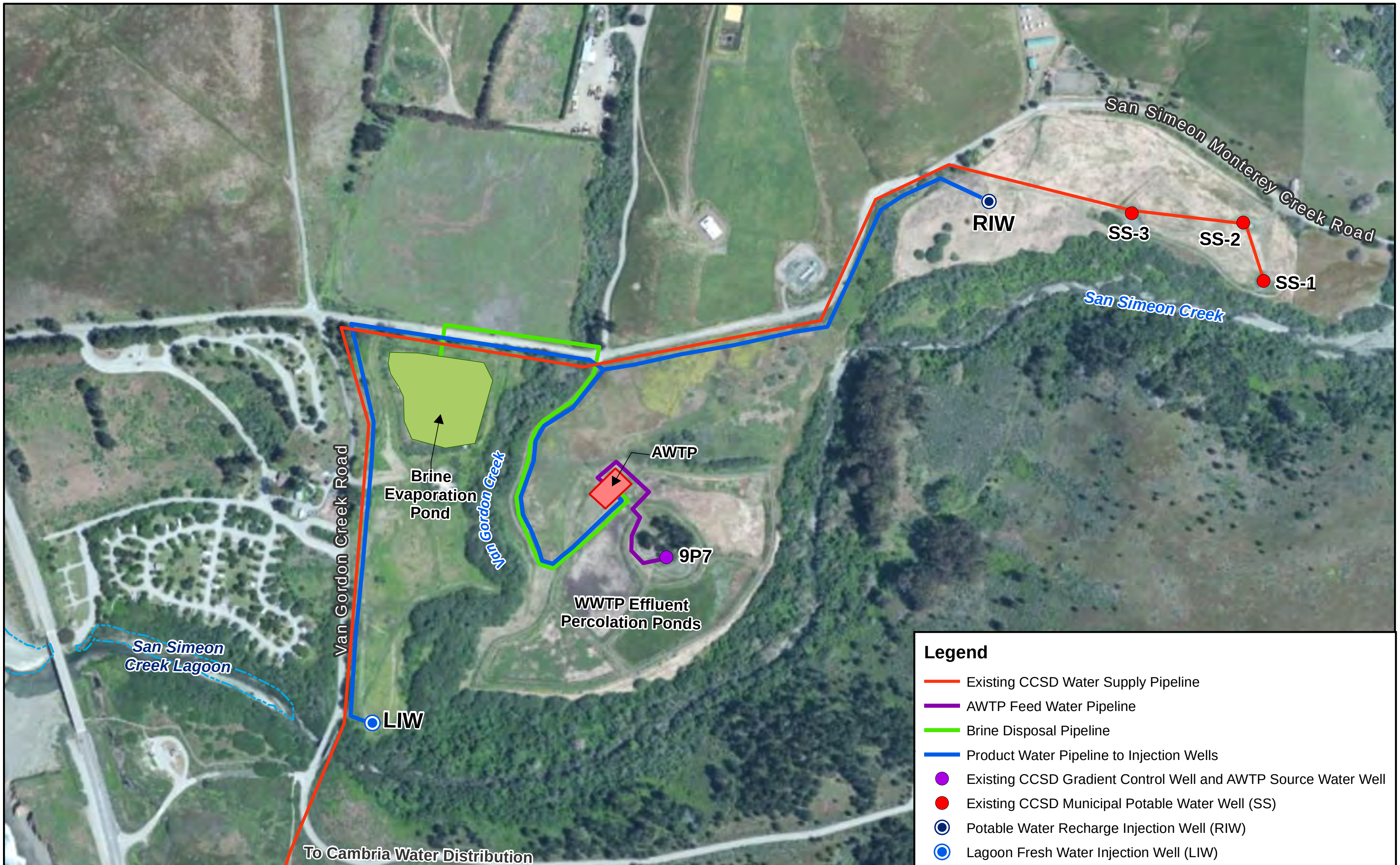

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Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 6-5
Emergency Alternative 4 Summary

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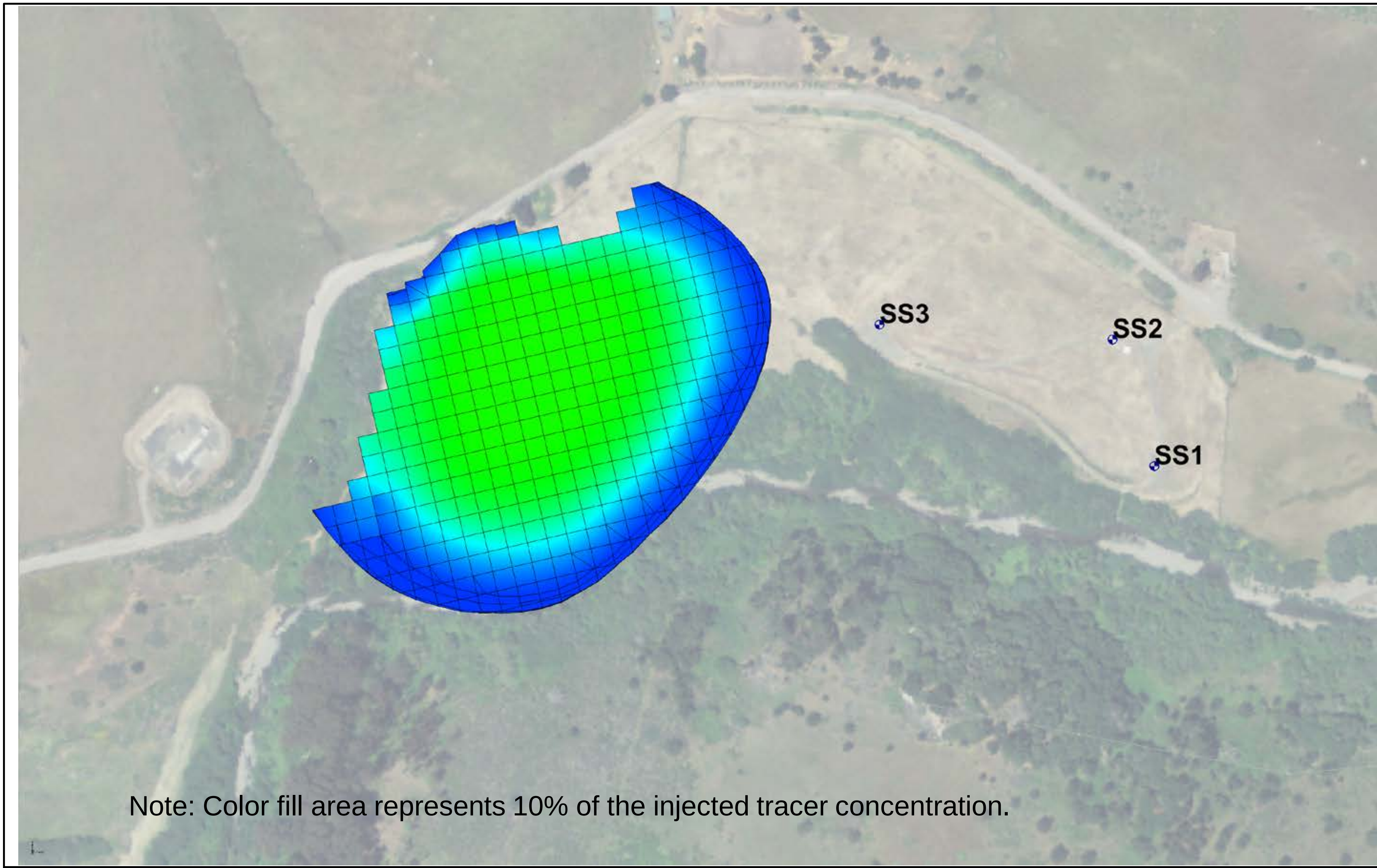

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 6-6
Simulated Tracer Extent at 30 Days

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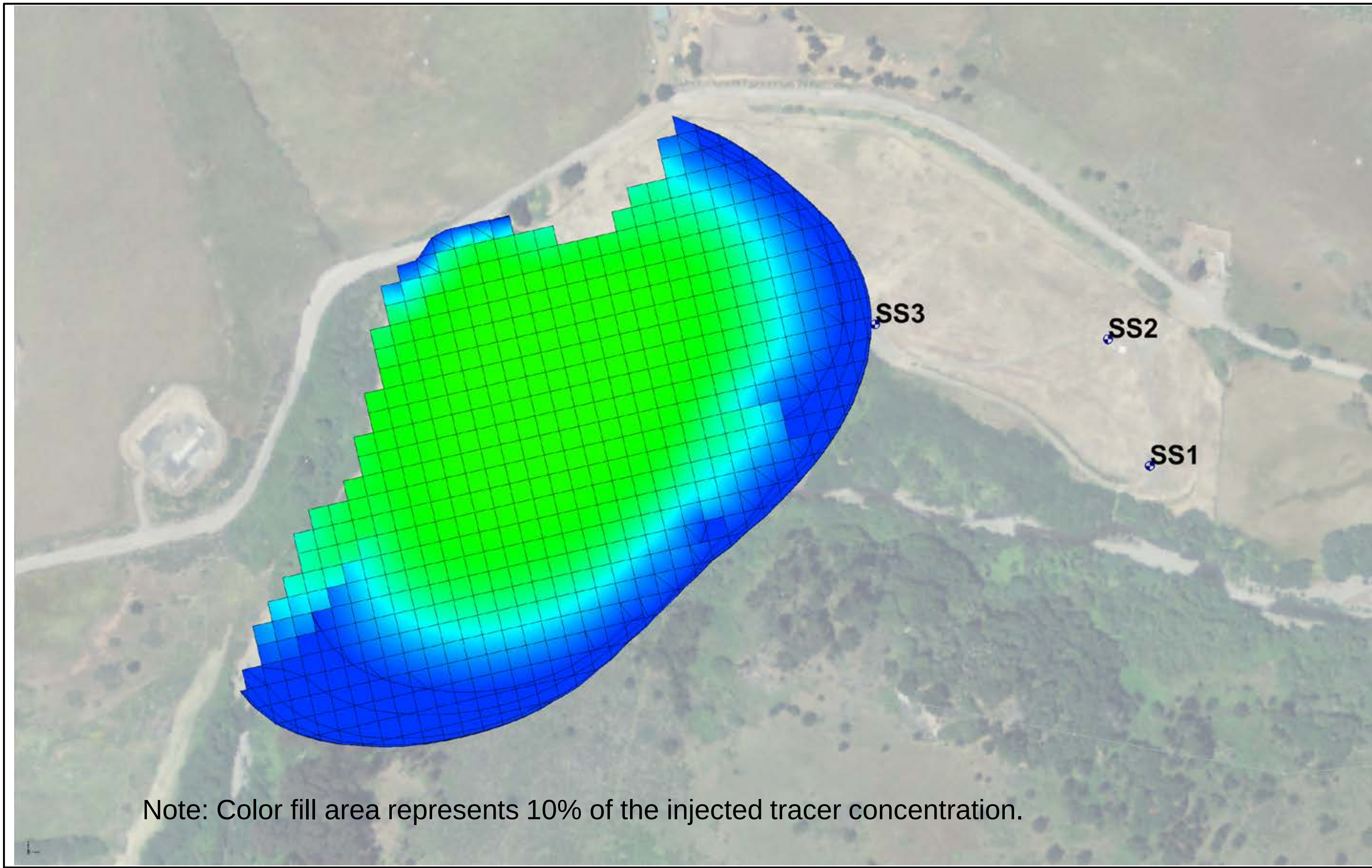

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Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

Figure 6-7
Simulated Tracer Extent at 60 Days

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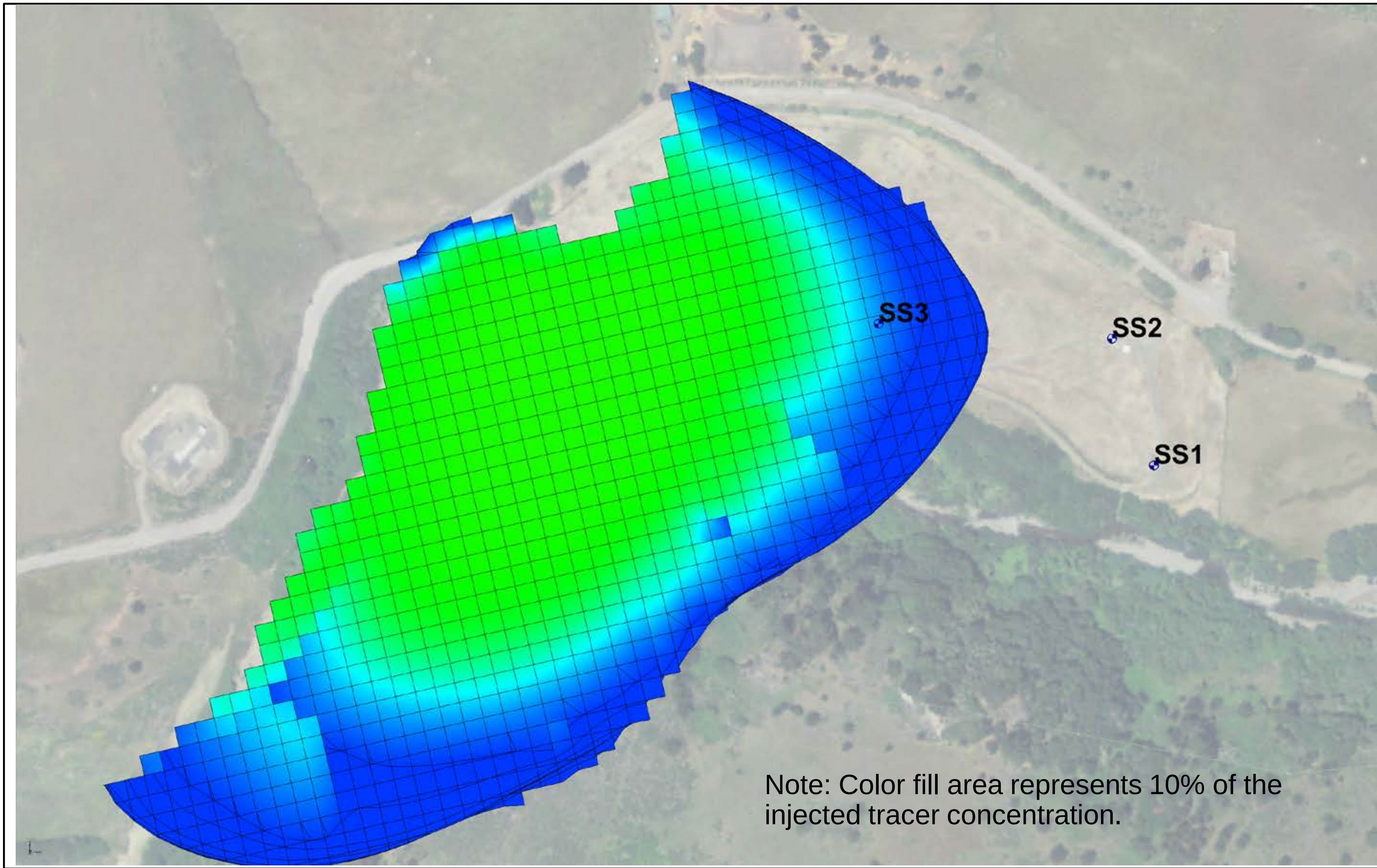

Cambria Emergency Water Supply Project
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Figure 6-8
Simulated Tracer Extent at 90 Days

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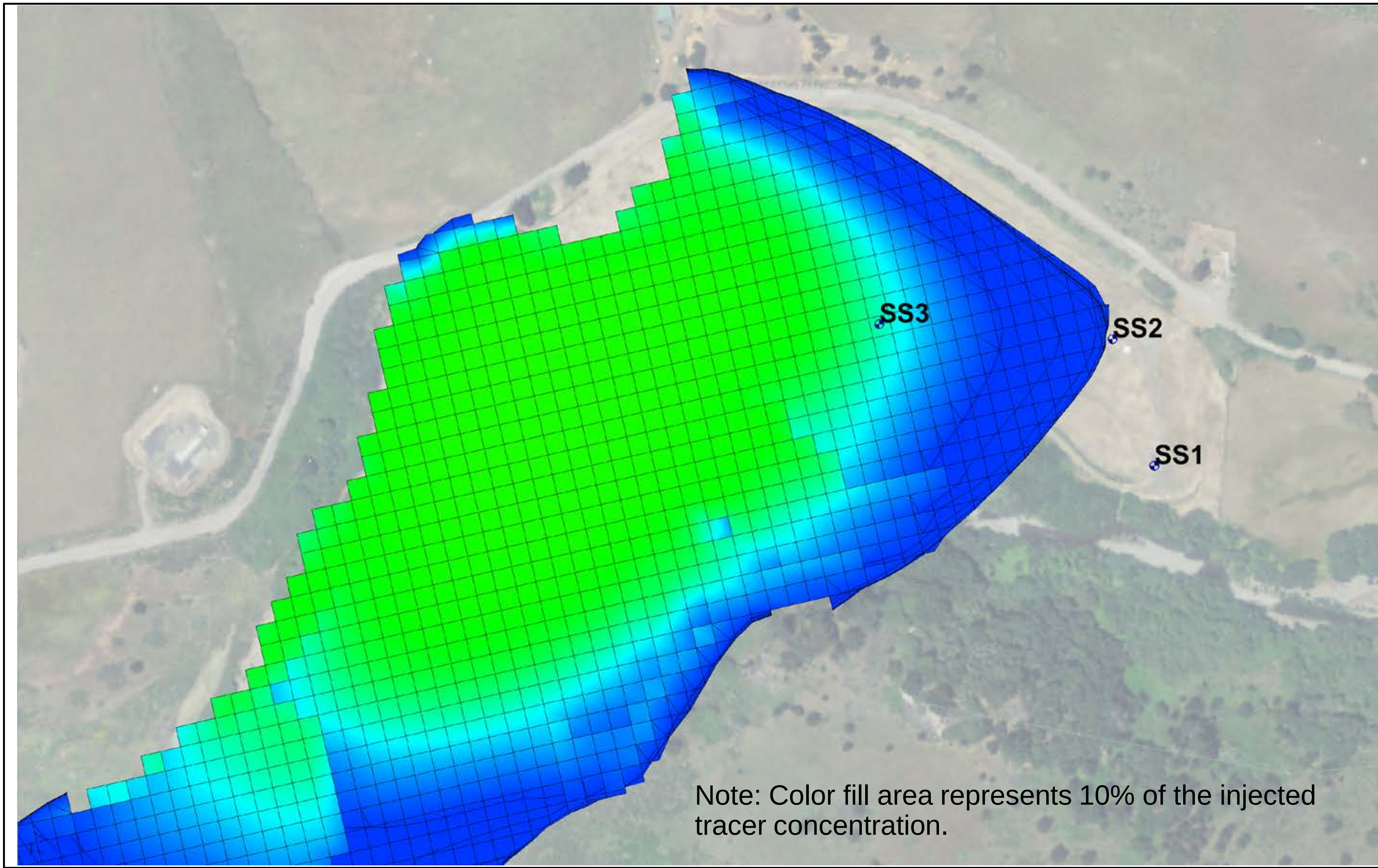

Cambria Emergency Water Supply Project
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Figure 6-9
Simulated Tracer Extent at 120 Days

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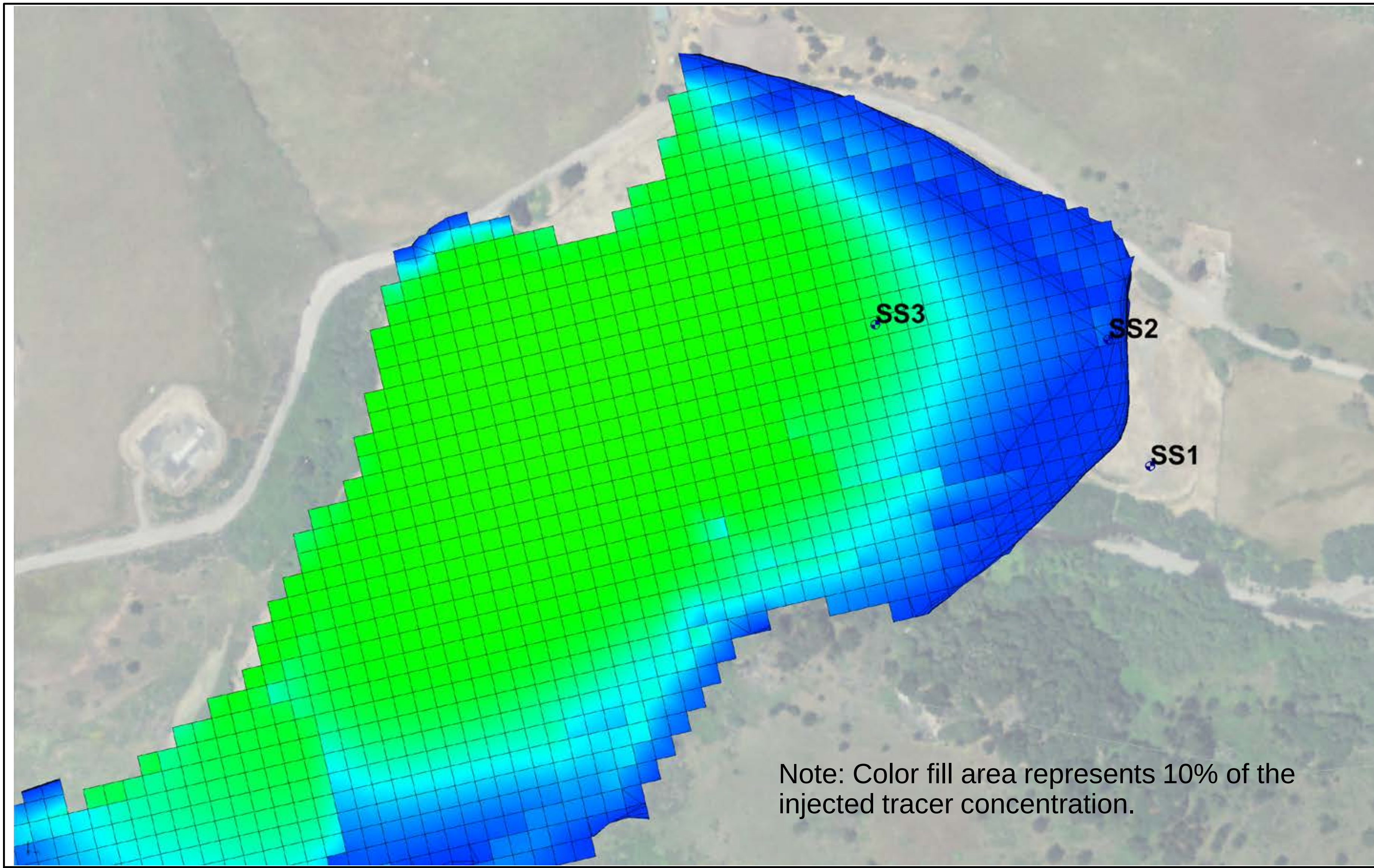

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

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Figure 6-10
Simulated Tracer Extent at 150 Days

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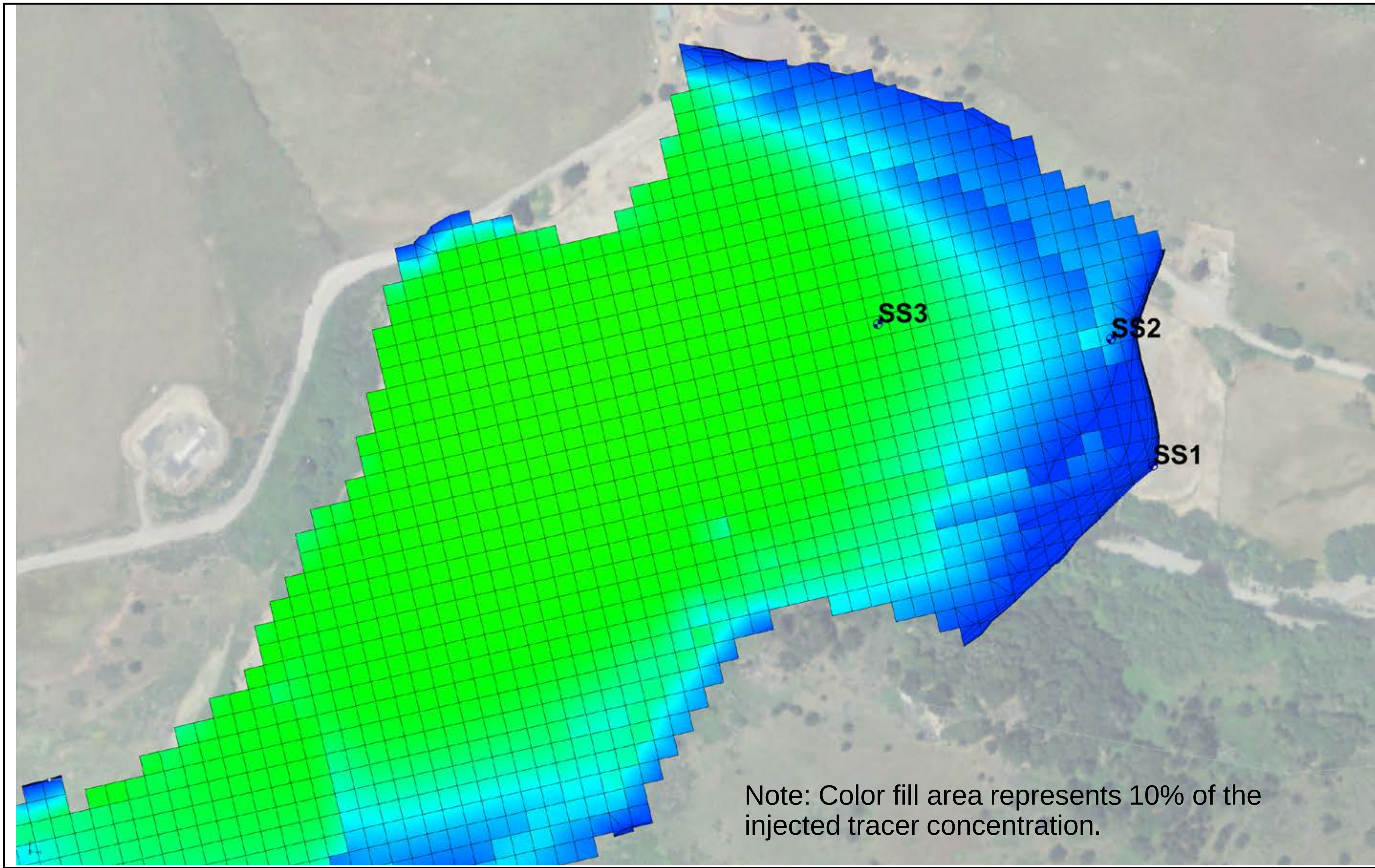

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

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Figure 6-11
Simulated Tracer Extent at 180 Days

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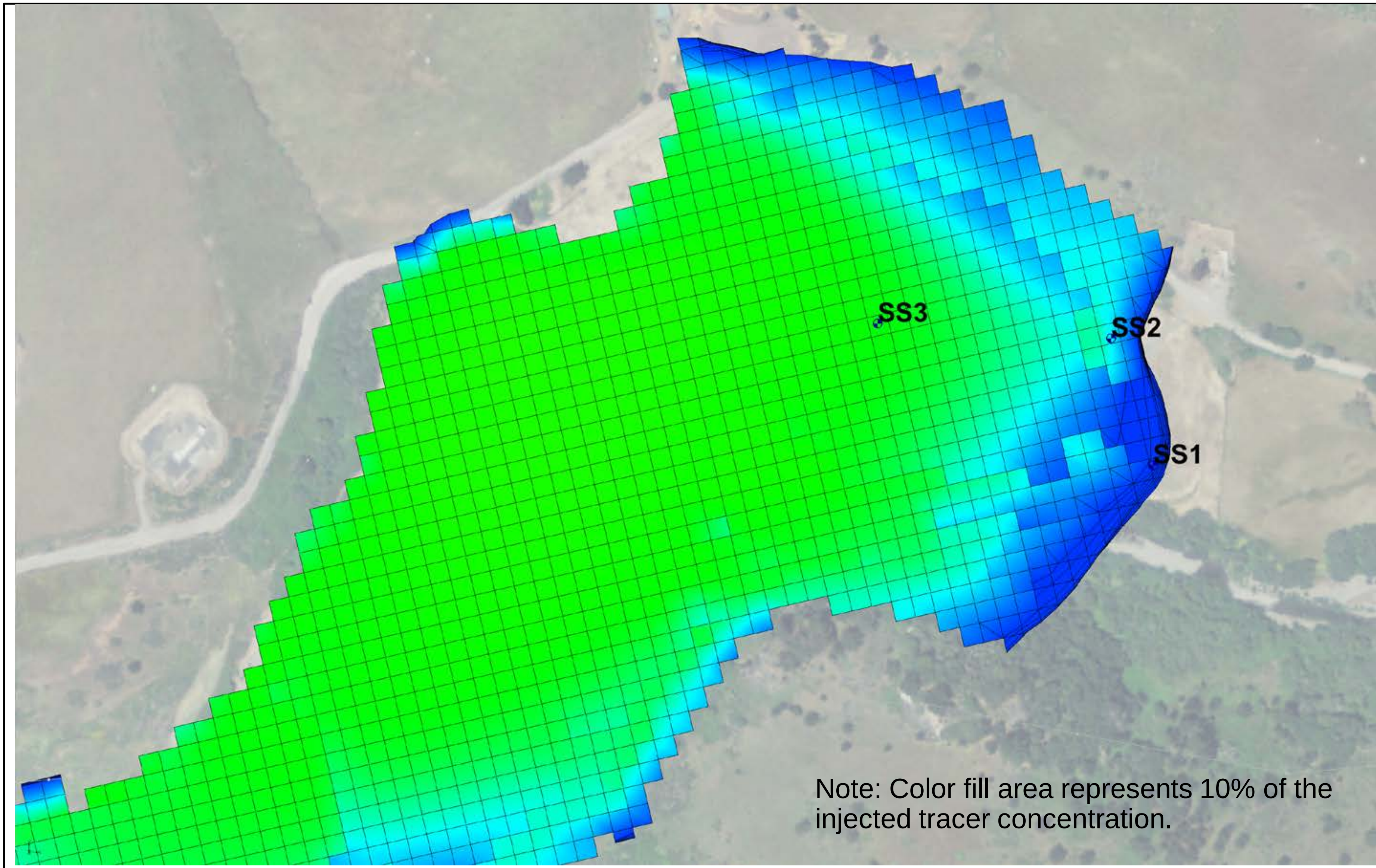

Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

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Figure 6-12
Simulated Tracer Extent at 210 Days

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Exhibit 10.2

Cambria Emergency Water Supply Project
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Figure 6-13
Simulated Water Levels After One Year of Operation

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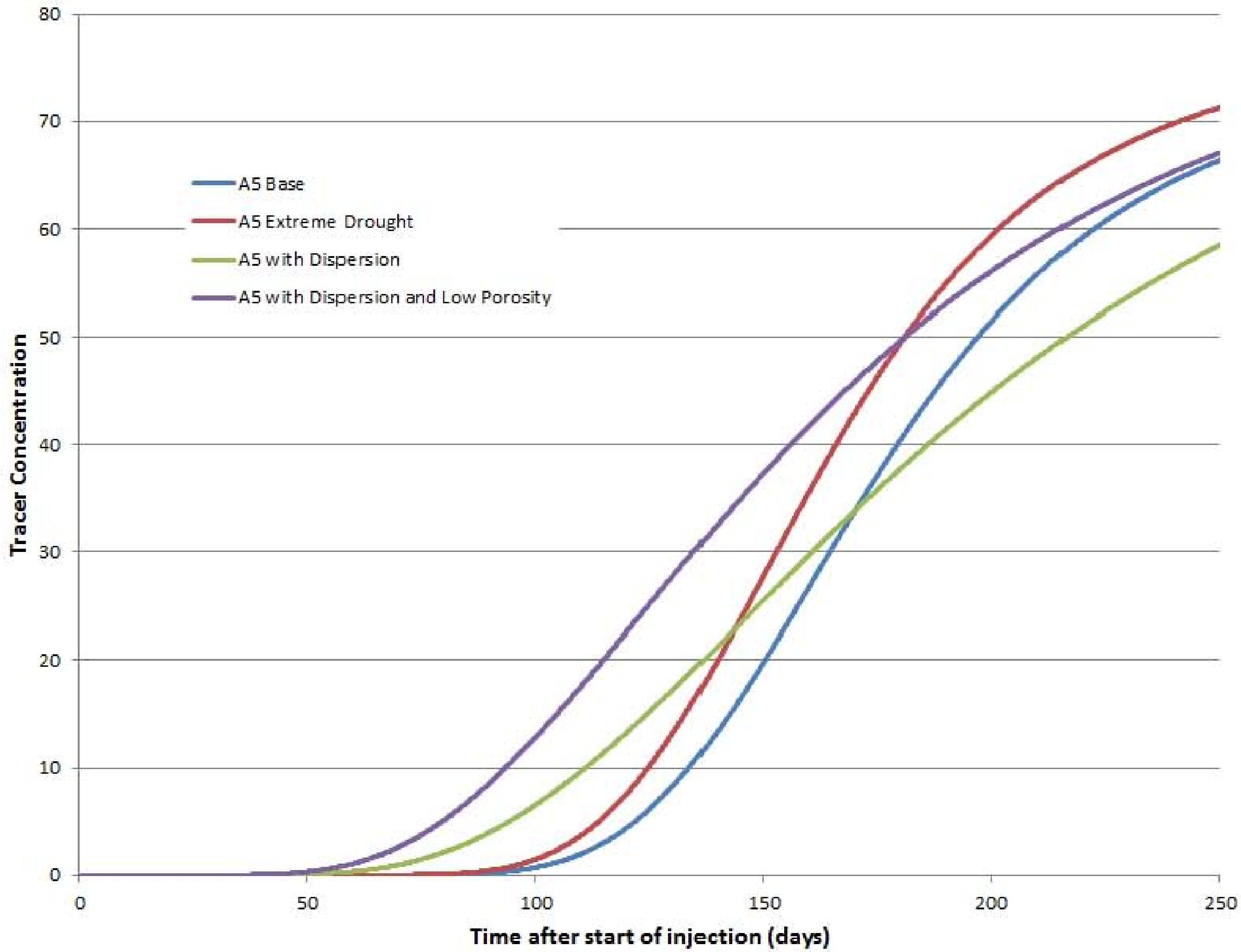

Cambria Emergency Water Supply Project

TO1: Geo-Hydrological Model

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Figure 6-14

Simulated Tracer Breakthrough at wells SS1 and SS2

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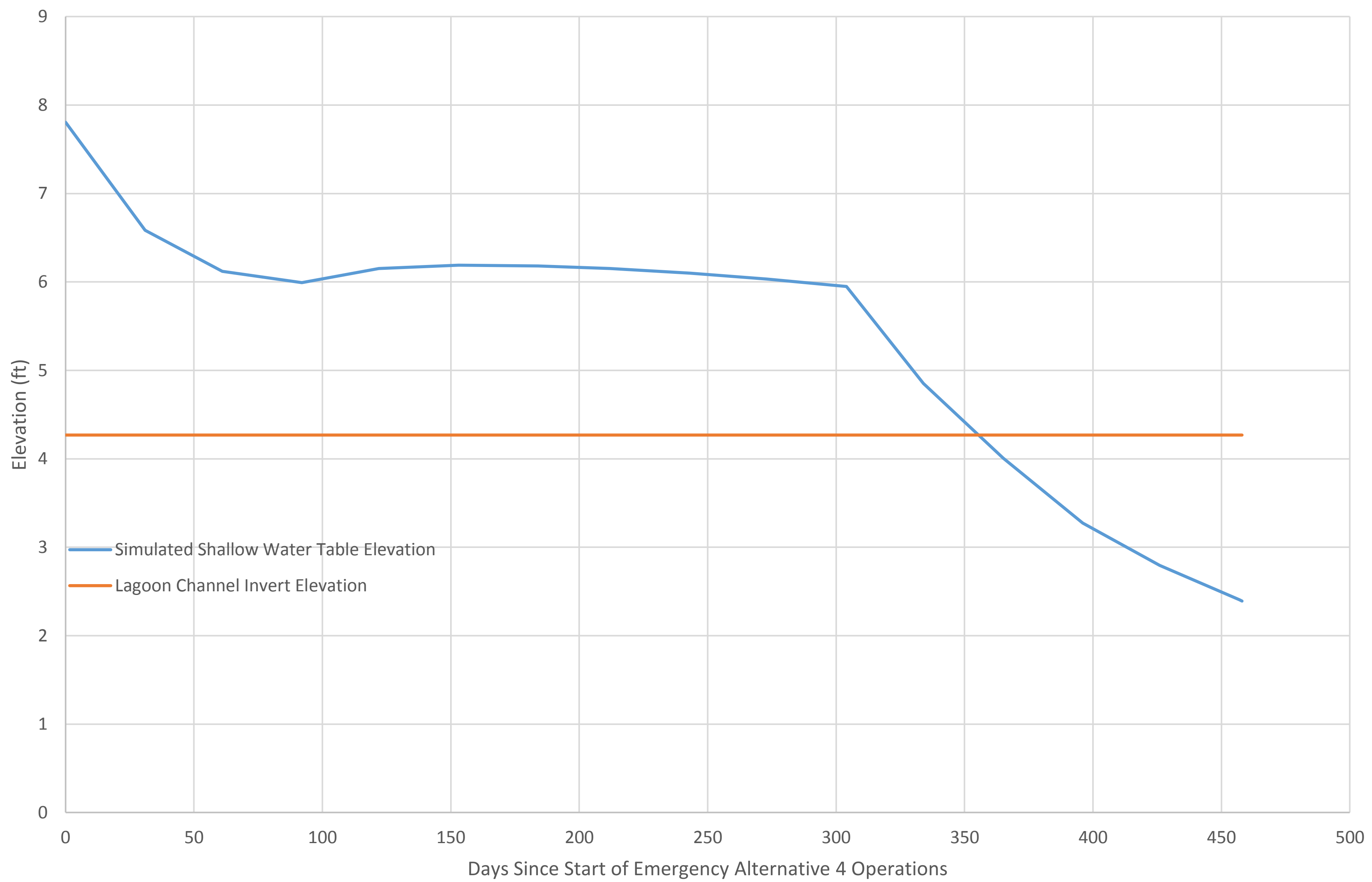

Cambria Emergency Water Supply Project

TO1: Geo-Hydrological Model

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Figure 6-1p

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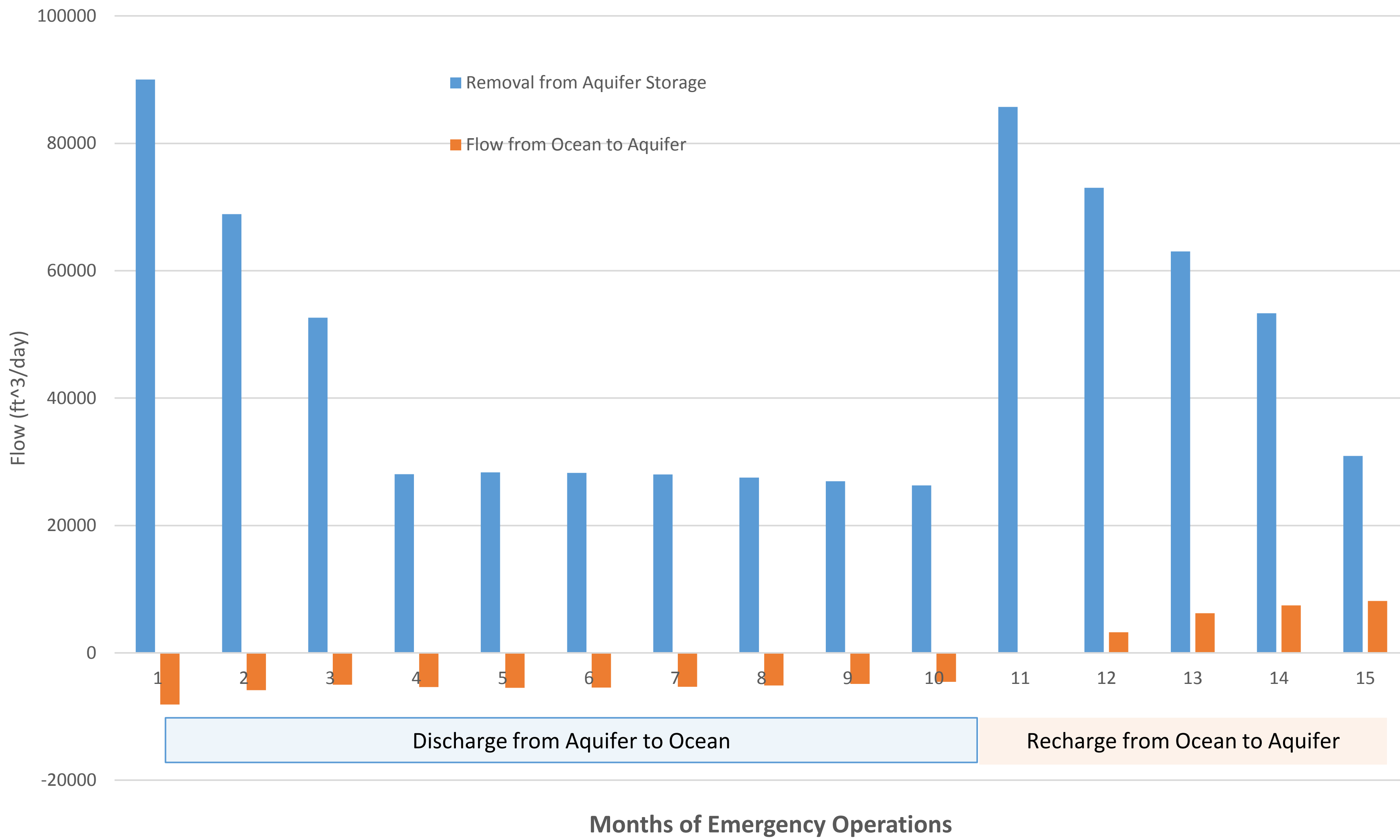

Cambria Emergency Water Supply Project

TO1: Geo-Hydrological Model

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Figure 6-16

Simulated Basin Storage Depletion and Ocean Inflows and Outflows

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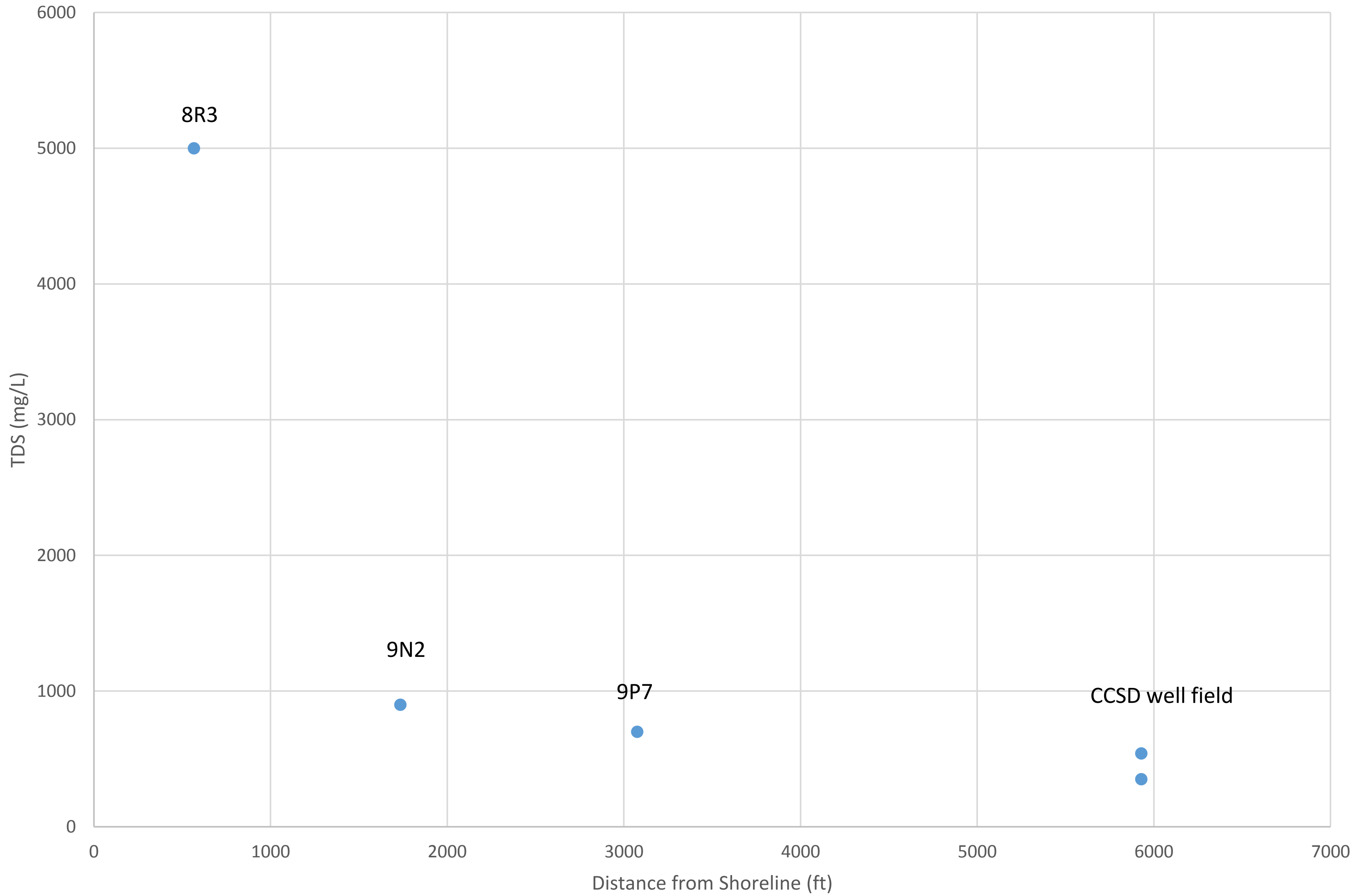

Cambria Emergency Water Supply Project
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Figure 6-1T
TDS Profile from Well Samples

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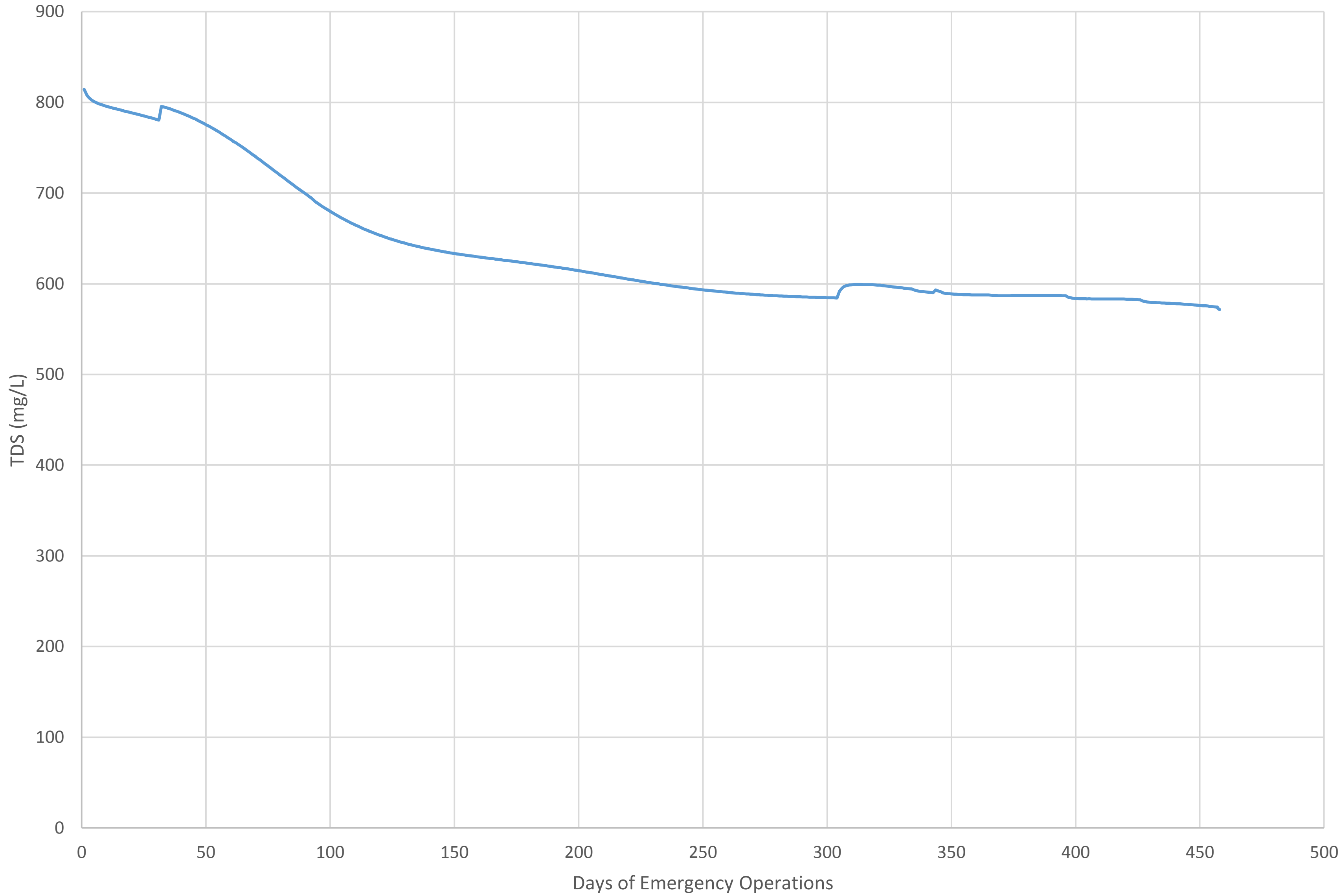
Exhibit 10.2



Cambria Emergency Water Supply Project
TO1: Geo-Hydrological Model

CDM Smith

Figure 6-18
Simulated TDS at Brackish Extraction Well

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Section 7
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APPENDIX B
Technical Memorandum
San Simeon Creek Flows

DRAFT Memorandum

To: *Rita Garcia –Michael Baker International*
Bob Gresens – Cambria Community Services District

From: *Gregg Cummings*
Michael Smith

Date: *October 16, 2015*

Subject: *Technical Memorandum - San Simeon Creek Flows*

The California Coastal Commission (CCC) provided a number of comments related to surface water flows in San Simeon Creek in their letter dated April 6, 2015 relative to environmental flows necessary to support critical habitat in the lower portion of San Simeon Creek. The CCC comments also requested additional documentation on mitigation discharges to the lagoon near the mouth of San Simeon Creek. The CCC comments recommended the EIR include an instream flow analysis. This document summarizes historical information on flows in San Simeon Creek and documents the basis for the recommended mitigation discharges to the San Simeon lagoon.

Historical Background

The CCC comments reference the analysis documented in the report titled " San Luis Obispo County Regional Instream Flow Assessment" (Stillwater Sciences, 2014). The Stillwater Sciences report develops minimum required flows for supporting steelhead during critical spring and summer periods for multiple streams in the county, including the lower portion of San Simeon and Van Gordon Creeks. Comments from the CCC rely on the Stillwater Sciences report to identify the minimum environmental flow requirement of 0.5 cubic feet/second (cfs) for the lower portion of San Simeon Creek during the critical summer season.

One of the objectives of the Stillwater Sciences report was the estimation of Environmental Water Demand (EWD) for various stream reaches in San Luis Obispo County. EWD is defined as the amount of water needed in an aquatic ecosystem, or released into it, to sustain aquatic habitat and ecosystem processes based on the South-Central California Coast steelhead requirements. Their analysis was targeted at stream segments that were identified as likely to have perennial flow based on watershed characteristics and the results of a 2006 study by NOAA that cited in the 2014 Stillwater Sciences report. The 2006 NOAA analysis did not use any information specific to San Simeon Creek in developing their identification of perennial streams, but rather covered a large area extending from Monterey Bay to San Diego. The NOAA report indicated that lagoon areas were not considered in the analysis. The 2014 Stillwater Sciences report stated:

> *We recognize that there is no value in predicting summer flow requirements for steelhead in the portion of a creek that is naturally dry during part of the year. Therefore results from a National Oceanic and Atmospheric Administration (NOAA) analysis (Boughton and Goslin 2006) were used to limit analysis of EWD to portions of each watershed determined to have a high potential for steelhead rearing to occur based on intrinsic watershed characteristics, including perennial flows.*

The Stillwater Sciences report also utilized information from the USGS San Simeon basin report (Yates and Van Konyenburg, 1998), which included evaluation of stream flows in San Simeon Creek. An additional source of historical information is available in a draft manuscript from the California Department of Fish and Game (Titus, et. al., 2010) which summarizes flow conditions on San Simeon Creek.

The USGS report summarized flow monitoring at the San Simeon gaging station at Palmer Flats, which is located about 3.8 miles upstream of the discharge to the ocean. This gage was monitored from 1971 to 1988, when it was replace by the current gage operated by San Luis Obispo County, located approximately one mile upstream of the discharge to the ocean. The upstream gage at Palmer Flats is located where more persistent flow has been noted. The 2011 draft manuscript from the Department of Fish and Game (Titus and Erman, 2011) referenced past analyses indicating that the stream frequently dries up during the summer and the staff therefore recommended discontinuing stocking in 1933, but no information of earlier stocking operations. This manuscript does note that steelhead were observed in San Simeon Creek during times when water was present and also stated that stocking continued after 1933, contrary to the earlier staff recommendation. The analysis of streamflow at the Palmer Flats stream gage on San Simeon Creek by Yates is consistent with past observations of stream flows during the summer dry period. The USGS analysis indicated that over the 1971 to 1988 period of record at the Palmer Flats gaging station, no surface water flow was observed 47 percent of the time. This upstream station at Palmer Flats was located closer to higher elevation portions of the watershed where springs provide more baseflow to the channel. The USGS modeled the impacts of agricultural and municipal pumping on the water budget and water levels in the San Simeon basin. The USGS report concluded that the water level declines in the San Simeon basin were primarily the result of drainage of the alluvium after the rainy season, rather than a result of the pumping. The report further noted that the water level declines occurred due to water in the basin moving downgradient as subsurface flow.

NOAA used an environmental envelope approach to the identification of stream reaches that had a high potential to provide potential steelhead habitat. This method first identified streams where steelhead were successful and estimated quantitative parameters to identify characteristics that could be extended to other locations with more limited data. The parameters selected for this characterization include:

- Mean summer discharge
- Channel gradient
- Valley width index
- Temperature
- Presence of alluvium

Mean summer discharge was based on a regression developed for 28 stream gage locations, relating drainage area and mean annual precipitation to the summer (August and September) mean discharge over the 1961 to 1990 period. Data from the San Simeon watershed was not used in this analysis. The developed regression was statistically significant, however, the regression accounted for only 33 percent of the observed variance in the data set. The regression was then used to estimate mean summer flows at streams with observed successful steelhead occurrence. Channel gradient was estimated for reaches using GIS data. The valley width index is the ration of the valley width to the mean discharge. Mean air temperature was used as a surrogate for the stream temperature. The presence of alluvial materials in the valley was based on available geologic maps. Values for each of the predictor variables were overlain on the confirmed steelhead occurrences. Ranges of each of the predictor variables were quantified for areas with steelhead to identify potential suitable habitat for summer conditions. Their analysis did not include potential interactions between the variables used in the analysis. The most significant variable for purposes of assesments in the San Simeon watershed is the mean summer flow, since this largely controlled the identification of the entire San Simeon watershed as having a high potential for steelhead habitat. The Figure 2 from the NOAA report shows a graph of successful steelhead habitat based on mean summer flow, along with a summary of the relative frequency of stream reaches in the South-Central California area, which includes the San Simeon watershed. This same figure is annotated on Figure 1. The red line added onto this figure shows the 0,5 cubic feet/second (cfs) (0.014 meters cubed/second) value that was selected in the Stillwater Sciences report to represent the Summer EWD for Lower San Simeon Creek. It is notable that all of the successful steelhead habitat used in the NOAA analysis required higher mean summer flow rates. For example, the flow corresponding to the lowest portion of the steelhead occurrence had a flow rate of about 0.03 meters cubed/second (1.06 cfs).

The NOAA classification described above provided the basis for inclusion of Lower San Simeon Creek in the Stillwater Sciences report. No specific studies were conducted on San Simeon Creek, estimates of EWD were based on correlations with drainage areas developed from streams that were investigated. Two locations most relevant to the EIR included in the Stillwater Sciences analysis include Lower San Simeon Creek and Van Gordon Creek. The identified EWDs for Lower San Simeon Creek were 1.6 cfs in the spring (April and May) and 0.5 cfs for the summer (August and September) period. The Van Gordon Creek EWDs were 0.4 and 0.2 cfs for spring and summer periods. The Stillwater Sciences report noted that they did not analyze stream gaging data from San Simeon Creek due to difficulties in the data organization. The flow gaging data for the current monitoring station located about one mile upstream of the discharge to the ocean was obtained from San Luis Obispo County and is summarized in the following section.

San Simeon Surface Water Flow

A gaging station is located on Lower San Simeon Creek that was operated by the USGS for a basin specific study and was subsequently managed by San Luis Obispo County (San Simeon Sensor 718 http://www.slocountywater.org/weather/alert/stream/sansimeon.htm). Available data for the period of record through 2013 were obtained from the County and processed into a suitable format for analysis of flows. This processing included deletion of records that were noted as not representative due to equipment problems. Stage data were processed based on County developed rating curves to convert stream stage to flow.

Table 1 shows the data availability over the period of operation through 2013. The critical periods for EWD are the spring and summer periods. The available data from 1988 through 2013 for these critical periods is summarize also summarized on Table 1, indicating that 18 years of record with flow records for at least 90 percent of 61 possible days during the 1987 through 2013 period. Table 2 summarizes the average flow during spring and summer seasons for the 18 years with adequate records available. During the spring season, the EWD of 1.6 cfs was met during 15 of 18 years, or 83 percent of the years. The summer season average flow met the EWD of 0.5 cfs during 3 (2008, 2009 and 2011) of the 18 years, or 17 percent of the years. The mean flows are dominated by short term runoff associated with infrequent storms during August and September. During 2008, 13 days during the 61 day summer period exceeded the flow of 0.5 cfs: 3 out of 61 days exceeded 0.5 cfs during 2009; and 27 out of 61 days had flows above 0.5 cfs during 2011.

Lower San Simeon Creek is dry during a significant portion of the year outside of the rainy season. During the 18 years of available adequate data records, 53 percent of the time, San Simeon Creek did not have any flow at the Lower San Simeon Creek gaging station. Based on the recommendation in the Stillwater Sciences to assess in-stream flow at stations for which they did not analyze data, Lower San Simeon Creek should not be designated as steelhead critical habitat, due to predominant dry conditions during the critical summer season. During the 18 years of available records during the summer season, a total of 42 out of 1098 days, or 3.8 percent of the time during the summer season met the criteria for summer EWD flows.

In addition to the County's gaging station data, the CCSD had commissioned a 2000 baseline water supply study, which included a data summary from 1972 to 1997 indicating periods when there was no flow at the lamer Flats meter location on San Simeon Creek. Except for the period of 1995-1997 when there were apparent data collection problems, each of these years had substantial dry periods. It is noteworthy that this included the years 1971 through 1978, which preceded the CCSD's completion of its San Simeon Creek well field and disposal facilities. This table is included as Table 3 in this memorandum.

Lagoon Mitigation Flow

The San Simeon lagoon occurs on the beach area and upstream for a distance of up to about 2,000 feet. During periods of the year when there is little or no flow entering the area from upstream, the lagoon is isolated from the ocean by a beach berm that develops due to wave action. This beach berm can be breached temporarily during the dry season by high waves, when seawater can enter the lagoon. During periods when surface water flows exceed seepage and evaporation rates, water may discharge to the ocean when the water level in the lagoon rises sufficiently to breach the beach berm. This surface water flow occurs during the rainy season, which typically occurs between December and April. Figure 2 shows an aerial photograph of this condition in March 2010, when flows observed in San Simeon Creek averaged 226 cfs at the Lower San Simeon gage. After surface water flow in San Simeon creek ceases during the dry season, the beach berm is re-established by wave action and discharge to the ocean ceases. Figure 3 is an aerial photograph showing this condition in September 2010, where a lack in flow in the creek has allowed development of a berm and isolation from the ocean. Stagnant water conditions persist in the lagoon for a significant portion of the year when it is isolated from the ocean, allowing abundant accumulation of organic deposits on the lagoon floor. In addition, during periods of runoff, fine grain deposits can settle in the lagoon when flow velocities are low. These factors result in limited connectivity between groundwater and the lagoon in its upper reaches.

During periods when surface water is not flowing, water in the lagoon is maintained by discharge of groundwater to the channel of San Simeon creek in the area downstream of percolation ponds that are operated by the District for disposal of secondary treated effluent from their waste water plant in Cambria. The source of this groundwater includes both basin groundwater flowing in the subsurface toward the ocean and the local recharge from the District percolation ponds. During periods when surface water inflow is insufficient to maintain the connection through the beach berm, water levels in the lagoon will stabilize at a level determined by the balance between inflowing groundwater in the upper reaches, and seepage to the aquifer in the beach area. A groundwater gradient is present in the alluvial fill materials toward the ocean during periods when discharge to the ocean is occurring in the subsurface. The nature of the alluvial deposits changes in the area west of the confluence of Van Gordon Creek and San Simeon Creek, where a greater percentage of low permeability material is present in the subsurface downstream of this confluence. This results in a higher hydraulic gradient in these lower hydraulic conductivity materials. In the sections of San Simeon Creek where the channel invert elevation is lower than the adjacent groundwater level, seepage from the aquifer to the channel occurs. In cases where water levels in the lagoon are higher than groundwater levels, seepage from the lagoon to groundwater will occur.

The presence of lower permeability bed materials in the lagoon, consisting of fine grain sediments and the organic debris, limits the connectivity between the lagoon and groundwater. Detailed monitoring of water levels in the aquifer and stage in the lagoon was conducted for a one week period in April, 2014 during a period when a brief runoff event resulted in a rise in water levels in the lagoon of about 0.83 feet. Water levels in the lagoon dropped subsequent to this event, allowing an estimate of the seepage rate. The loss rate, lagoon area and the change is head were used to estimate the permeability of the lagoon bed for use in modeling analyses. During the monitoring period, the water level in the lagoon declined by 7.3 inches, indicating a loss rate of 77 gpm.

The estimated permeability for the lagoon was used to update the calibrated groundwater model to assess lagoon levels with and without the emergency water supply project in operation, under normal years where surface water flows during the rainy season recharge the upper groundwater basin; and, extreme drought conditions where no surface water inflow occurs over a two year period. Simulations were conducted for baseline conditions, representing conditions prior to implementation of the project with the following operating assumptions:

- Using the same maximum permitted capacity as the emergency water supply project, the CCSD well field operated at a production rate of 454 gpm during dry season
- Percolation pond seepage 353 gpm

- Without the emergency water supply project in operation, gradient control pumping at 25 gpm during drought years, with no gradient control pumping during normal years
- Without the emergency water supply project in operation, gradient control well discharge to Van Gordon Creek
- Irrigations wells operate at historic rates during the dry season for both normal and drought conditions
- Beach berm elevation assumed at 7.5 feet
- No breaching of the berm occurred due to high surf conditions.

The proposed water supply alternative was simulated for both normal and the extreme drought conditions considering lagoon mitigation discharge rates of 0, 50, 100 and 150 gpm during the 6 month dry season. Assumptions for the water supply alternative were:

- CCSD well field operated at 454 gpm during dry season, the maximum permitted capacity of the emergency water supply project
- Percolation pond seepage 353 gpm
- RIW-1 recharging at 454 gpm between the CCSD well field and the percolation ponds to maintain the required protective gradient
- Well 9P7 pumping at rates sufficient to supply mitigation flow, recharge water to RIW-1 and treatment losses
- Project operates only during the typical dry season
- Irrigation wells pump at historic rates during dry season
- Beach berm assumed at 7.5 feet
- Mitigation water is discharged directly to the lagoon
- No breaching of the berm occurred due to high surf conditions.

Figure 6 shows the results of the simulation for normal climatic conditions, compared to results without implementation of the water supply alternative. Under the normal climatic conditions, mitigation flows of 50 gpm during the proposed water supply alternative operation are sufficient to maintain lagoon levels similar to conditions without the water supply alternative. Figure 7 shows the results of simulations for extreme drought conditions comparing the water supply alternative with mitigation flows of 0, 50 and 100 gpm with conditions without the water supply alternative. During the first year of simulated drought, the mitigation flow of 100 gpm is able to maintain lagoon levels similar to those for no implementation of the water supply alternative. During the second year of simulated drought, both 50 and 100 gpm of mitigation flows would result in higher lagoon levels than would exist without the water supply alternative. Under the extreme drought conditions the CCSD well field would not be capable of producing the permitted quantities, while with the water supply alternative, production at these rates could continue.

Conclusions

Historical information available from monitoring and from the USGS 1988 study indicate that the lower reaches of San Simeon Creek do not have surface water flows during the critical summer period. Recharge to the basin occurs during the rainy season when San Simeon Creek flows, however, drainage of the basin occurs as subterranean flow, rather than as surface water flow. The 0.5 cfs environmental water demand recommended in the 2014 Stillwater Sciences report is not justified.

The cited 2014 Stillwater and 2006 NOAA studies did not include specific analysis of the San Simeon Lagoon. CCSD anticipated the need to protect the sensitive habitat of the lagoon and incorporated a provision in their plan to provide mitigating flows to maintain the lagoon. Detailed analysis of required supplemental water to support the lagoon concluded that 100 gpm will improve protection of this area when the project is in operation, compared to a no project scenario.

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San Simeon Figures

Tables

Table 1 - Summary of Available Stream Flow - Lower San Simeon Creek

Calendar Year		Percentage of Days with Flow Record	Percentage of Days with Flow Records (Spring Season)	Percentage of Days with Flow Records (Summer Season)
1987		25%		
1988		100%	100%	100%
1989		78%	100%	0%
1990		100%	100%	100%
1991		90%	51%	100%
1992		100%	100%	100%
1993		100%	100%	100%
1994		100%	100%	100%
1995		100%	100%	100%
1996		92%	80%	100%
1997		55%	75%	100%
1998		96%	100%	100%
1999		100%	100%	100%
2000		96%	100%	100%
2001		100%	100%	100%
2002		100%	100%	100%
2003		22%	0%	7%
2004		1%	100%	95%
2006		25%	98%	97%
2007		97%	100%	100%
2008		93%	93%	100%
2009		97%	100%	100%
2010		99%	100%	100%
2011		99%	100%	100%
2012		100%	0%	0%
2013		100%	0%	0%

Table 2 - Summary of Seasonal Flow Statistics

Year	Mean Spring Flow (cfs)	Mean Summer Flow (cfs)
1988	0.59	0.00
1990	0.00	0.00
1992	4.96	0.00
1993	12.26	0.00
1994	0.81	0.00
1995	21.45	0.00
1998	39.86	0.01
1999	19.92	0.00
2000	7.34	0.00
2001	5.69	0.00
2002	6.64	0.00
2007	2.11	0.00
2008	55.40	7.20
2009	23.61	7.78
2010	159.12	0.00
2011	200.02	32.70
2012	198.65	0.00
2013	37.01	0.00
EWD	**1.60**	**0.50**

EWD met

Exhibit 10.2

Table 3 – Palmer Flats Dry Periods

TABLE A-2

SAN SIMEON CREEK: START AND END DATES FOR HISTORICAL DRY SEASONS

Water Year[a]	Start Date[b]	End Date[c]	Duration (days)
1971	25-Jun	22-Dec	180
1972	25-Apr	11-Nov	200
1973	23-Jul	12-Nov	112
1974	3-Jun	3-Dec	183
1975	1-Jul	29-Feb	243
1976	16-Mar	31-Dec	290
1977	17-Jan	17-Dec	334
1978	7-Aug	16-Dec	131
1979	16-Jun	24-Dec	191
1980	11-Jun	23-Jan	226
1981	3-Jun	14-Nov	164
1982	5-Jul	9-Nov	127
1983	25-Aug	10-Nov	77
1984	23-Apr	24-Nov	215
1985	20-May	29-Nov	193
1986	26-Jun	9-Feb	228
1987	28-May	4-Dec	190
1988	21-Mar	17-Dec	271
1989	17-May	12-Jan	240
1990	27-Mar	28-Feb	338
1991	26-May	28-Dec	216
1992	31-May	6-Dec	188
1993	9-Jun	15-Dec	189
1994	30-May	3-Jan	218

Notes:

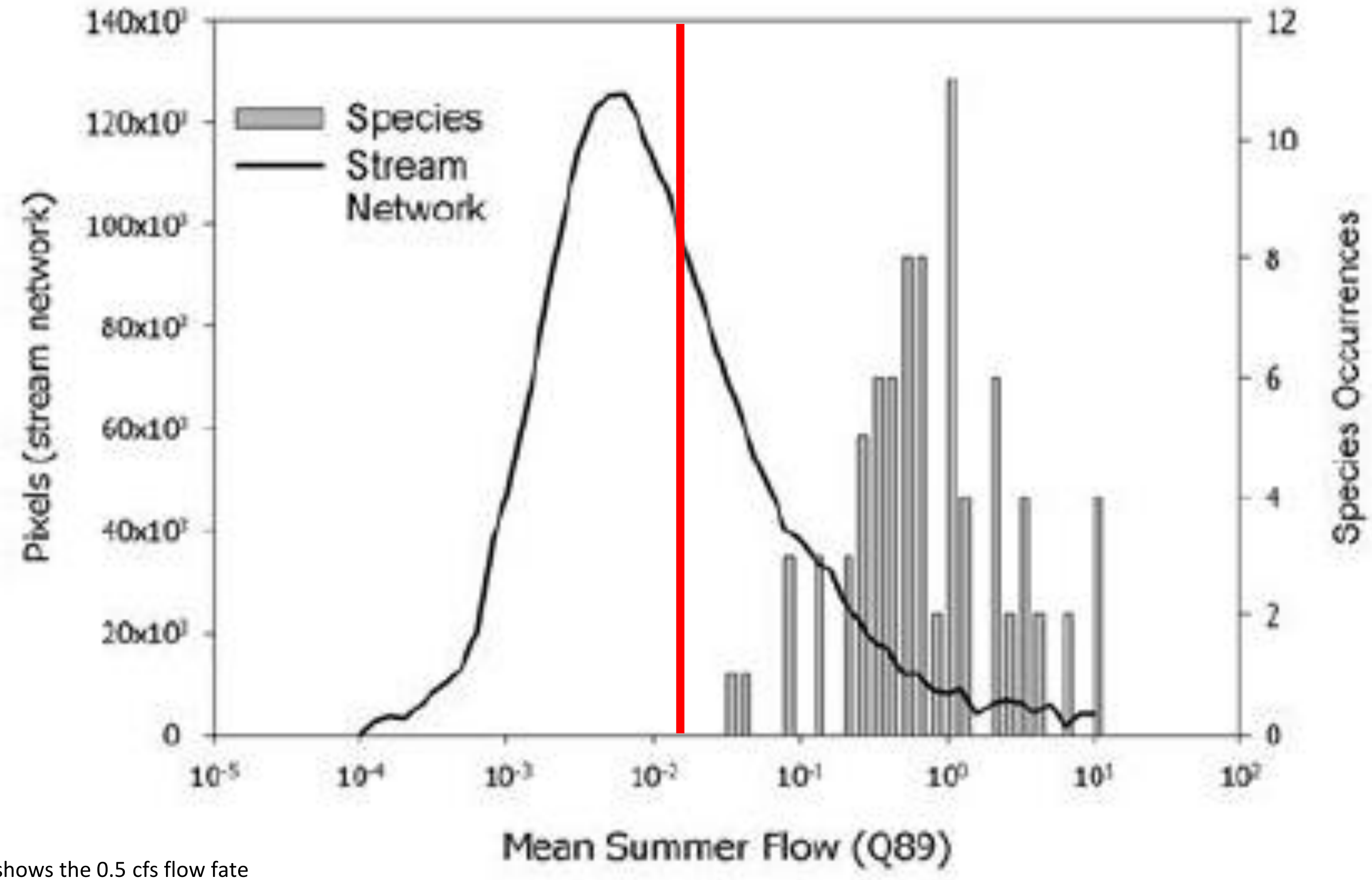
(a) Water Year defined as October 1 through September 30.
Data for 1971-1991 were obtained from Jones & Stokes (1995).
Data for 1992-1994 were developed using the same assumptions as those used by Jones & Stokes.

(b) Start Date of Dry Season beginning in the current water year.

(c) End Date of the Dry Season beginning in the current water year; usually occurs in the subsequent water year.

From: Kennedy/Jenks, 2000

Figures



Note: Vertical red line shows the 0.5 cfs flow fate

Figure 1 – Steelhead Occurrence and Mean Summer Flow (NOAA, 2006)

Figure 2 – March 2010 Aerial Photo Showing Discharge to Ocean

Exhibit 10.2

Figure 3 - September 2010 Aerial Photo Showing isolation from the Ocean

Exhibit 10.2

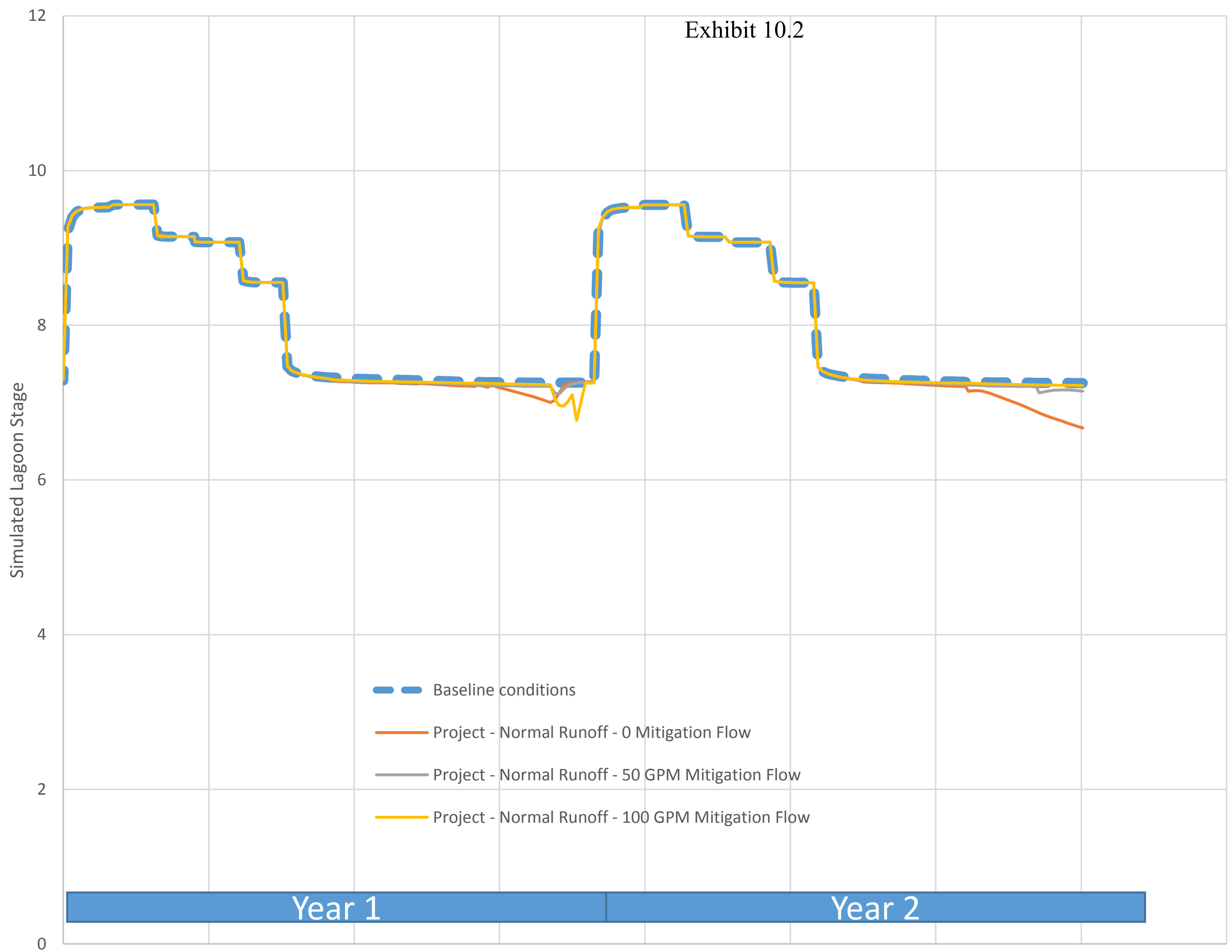


Figure 6 – Simulated Lagoon Levels, Normal Climatic Conditions

Exhibit 10.2

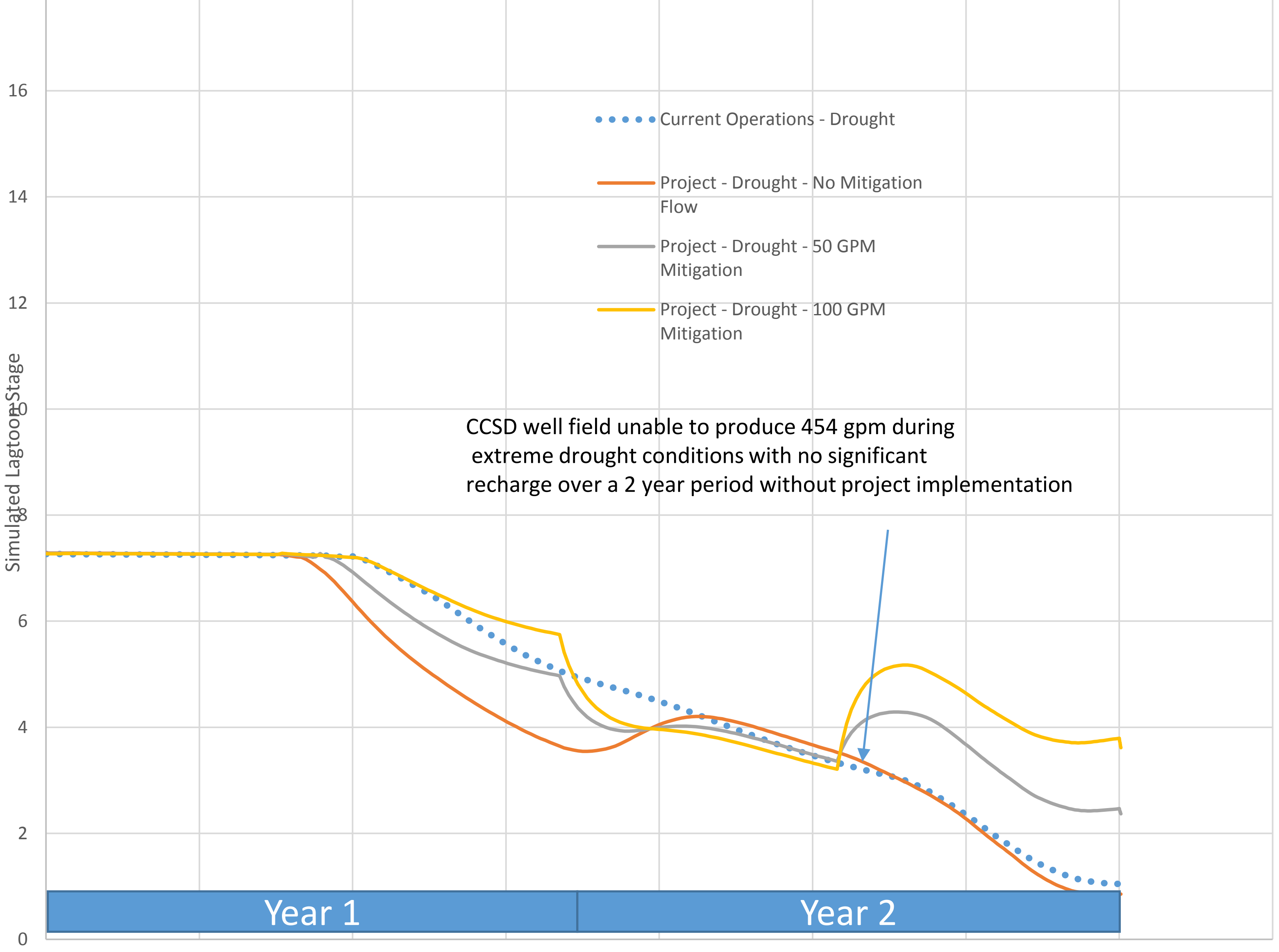


Figure 7 – Simulated Lagoon Levels, Extreme Drought Conditions

APPENDIX C

Initial Cambria Emergency Water Supply Project Adaptive Management Plan Monitoring Results (January 2015)

Exhibit 10.2

SWCA®
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February 23, 2015

Rita Garcia
Michael Baker International
14725 Alton Parkway
Irvine, CA 92618-2027

Re: Initial Cambria Emergency Water Supply Project Adaptive Management Plan Monitoring Results (January 2015) / SWCA Project No. 31843

Dear Ms. Garcia:

SWCA Environmental Consultants (SWCA) conducted water quality and existing conditions monitoring in San Simeon Creek and Van Gordon Creek as described in the Adaptive Management Plan (AMP) for the Cambria Emergency Water Supply Project (CEWSP). Monitoring surveys were conducted on January 12 and January 30, 2015. This first month of monitoring and sampling was based on discussions with Bob Gresens of the Cambria Community Services District (CCSD) and RBF Consulting (RBF)/Michael Baker International (MBI) in order to: select sampling points; identify the existing infrastructure already in place for collecting data (e.g., stream gages, groundwater quality data recorders); and, establish the timing for the field monitoring. The CCSD began their emergency pumping activities at the CEWSP treatment facility on January 20, 2015, at approximately 1:20 p.m. This summary report includes discussion of the methods used to collect stream data, the locations of sites selected for data collection, and the results of the surveys.

DATA COLLECTION AND SITE SELECTION

SWCA identified four locations on San Simeon and Van Gordon Creeks for all water quality and water level data collection. These sites are shown on the map in Attachment A, and photos are provided in Attachment B. Three sites are in San Simeon Creek: 1) Site SS1 is located between source water well 9P7/Advanced Water Treatment Plant (AWTP) and recharge injection well RIW-1, near an existing County of San Luis Obispo (County)-maintained stream gauge station (San Simeon Sensor 718); Site SS2 is located under the pedestrian bridge that crosses San Simeon Creek in the upper lagoon; and Site SS3 is located in the lower lagoon near the mouth of San Simeon Creek at the beach. A fourth site (Site VG1) was selected in Van Gordon Creek downstream of the AWTP where the brine disposal pipeline and the filtrate line to San Simeon Creek Lagoon cross the creek. However, there were no flows in this creek during the month of January and thus, no data on water quality and/or flow were collected in January 2015.

GROUNDWATER LEVEL AND QUALITY MONITORING

The CCSD collects groundwater levels twice a month from a series of wells along San Simeon Creek. This data was requested from Mr. Gresens; however, data has not yet been received by SWCA. Once it is provided, SWCA will review it to note changes in groundwater levels.

SURFACE WATER FLOW MONITORING

SWCA measured stream velocity (feet per second) in San Simeon Creek and San Simeon Lagoon using a Gurley Model 625D Pygmy Flow Meter. Stream width and depth were recorded at the sample location, and stream flows were calculated in cubic feet per second (cfs). On January 12, 2015, stream flow at SS1 was calculated as 0.74 cfs, and on January 30, 2015, stream flow was calculated as 0.61 cfs. No detectable flow was recorded at SS2 or SS3, and, as noted above, no water was present at VG1 during the month of January.

SURFACE WATER LEVEL MONITORING

The County Department of Public Works monitors and maintains Sensor 718 in San Simeon Creek near monitoring Site SS1. Sensor 718 is adjacent to a monitoring station established by the U.S. Geological Survey (USGS) on November 25, 1987, in coordination with the County Division of Engineering. Stream stage data (in feet) is recorded at Sensor 718 throughout the day, multiple times per hour. The stream stage recordings at Sensor 718 (SS1) on January 12, 2015, averaged 4.23 feet and on January 30, 2015, averaged 4.34 feet.

In order to fully implement the AMP, another stream gage or other measuring device needs to be installed at the upper lagoon site (SS2) to record surface water levels. A request to install a device has been submitted to CCSD. Because the device had not yet been installed, surface levels were not measured at SS2 during the January 12, 2015 data collection. However, SWCA did collect measurements from the base of the existing pedestrian bridge (at the southwest corner of the bridge) on January 30, 2015, with the intention that this measurement can later be extrapolated to a surface water level at SS2. The distance from the bridge to the water surface on January 30 was 136 inches.

Discussions are ongoing with the CCSD to determine where and when a suitable measuring device can be installed at SS2 to monitor lagoon surface water levels. Additionally, a gage will need to be installed in Van Gordon Creek to measure surface water levels when water is present (as noted above, flows have been absent from Van Gordon Creek in the month of January 2015).

RIPARIAN VEGETATION MONITORING

SWCA plans to conduct three California Rapid Assessment Method (CRAM) analyses as a means of assessing the riparian habitat's health. These surveys will be conducted between February and April in upper San Simeon Creek and Van Gordon Creek near the extraction well, and in the upper lagoon area (exact locations to be determined), and results will be provided in future monitoring reports.

INSTREAM AND FISH HABITAT MONITORING

SWCA collected water quality data at SS1, SS2, and SS3 using an Extech Instruments Digital multi-meter Model DO700, including temperature (degrees Fahrenheit [ºF]), dissolved oxygen (parts per million [ppm]), total dissolved solids (milligrams per liter [mg/L]), and salinity (parts per thousand [ppt]). The results of the samples are shown in Table 1 below.

It was noted that high surf conditions modified the sandbar at the outflow of San Simeon Creek in the days prior to the second survey (conducted on January 30, 2015), and likely overtopped the sandbar and flowed into the lower lagoon. This may account for variations in the salinity measurements from the two dates.

Table 1. Water Quality Sampling Results

Date	Sampling Location	Temperature (°F)	Dissolved Oxygen (ppm)	Total Dissolved Solids (mg/L)	Salinity (ppt)
01/12/15	SS1	57.5	10.4	453	0.33
	SS2	58.4	5.9	939	0.66
	SS3	60.8	13.2	1270	0.89
01/30/15	SS1	54.5	8.3	473	0.34
	SS2	58.3	4.3	1240	0.85
	SS3	56.3	17.53	2010	1.38

No special-status species such as tidewater goby (*Eucyclogobius newberryi*), steelhead trout (*Oncorhynchus mykiss*), California red-legged frog (*Rana draytonii*), or western pond turtle (*Actinemys marmorata*) were observed during the surveys, though it should be noted that identification of these species was not the focus of the surveys. Suitable aquatic conditions were present for these species where water quality conditions were tolerable (discussion of tolerance levels for these species should be included with focused survey reports specific to each species, and included in the annual report).

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Attachment A:
Adaptive Management Plan Monitoring Site Locations Map

Exhibit 10.2


SAN SIMEON MONTEREY CREEK RD
1
SS1
SS2
SS3
VG1
Van Gordon Creek
San Simeon Creek
Monitoring Locations
Feet
0 250 500 1,000
Aerial Imagery: County of San Luis Obispo, 2011.
N
S
E
W
SWCA
ENVIRONMENTAL CONSULTANTS
CEWSP AMP Monitoring Locations

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Attachment B:
Adaptive Management Plan Monitoring Site Locations Photographs

PHOTO 1:

Monitoring Site SS1 at USGS/County Sensor 718 Site in San Simeon Creek between source water well 9P7 and injection well RIW-1.

Photo taken on January 12, 2015.

PHOTO 2:

Monitoring Site SS2 at pedestrian/ automobile bridges in upper San Simeon Creek Lagoon.

Photo taken on January 12, 2015.

PHOTO 3:

Monitoring Site SS3 at lower San Simeon Creek Lagoon (refer to yellow arrow for approximate monitoring site. Sandbar separated creek and ocean during all January monitoring visits.

Photo taken on January 12, 2015.

PHOTO 4:

High surf conditions in late January increased the sandbar and decreased the size of the lower lagoon, shifting the monitoring location approximately 40 feet east (yellow arrow).

Photo taken on January 30, 2015.

PHOTO 5:

View east toward lagoon from sandbar. Note signs of high surf overtopping sandbar (red arrow). Approximate January 12 sampling point is shown by white arrow and January 30 sampling point is shown with yellow arrow.

Photo taken on January 30, 2015.

PHOTO 6:

Monitoring Site VG1 in Van Gordon Creek. No water was present during the January monitoring visits.

Photo taken on January 30, 2015.

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APPENDIX D
California Rapid Assessment Method Summary Assessment Report Worksheets

WWW.CRAMWETLANDS.ORG

CRAM

California Rapid Assessment Method

Exhibit 10.2

Summary Assessment Report

Assessment not mapped

Basic Information

eCRAM ID	4073
Assessment Area Name	San Simeon Creek 1
Project Name	
Assessment Area ID	San Simeon Creek 1
Project ID	Cambria Emergency Water
Wetland Type	riverine non-confined
CRAM Version	6.1

Visit Date	2015-04-22
AA Category	
Practitioners	Travis Belt (lead practitioner)
Other Practitioners	Ben Hart
County	
Ecoregion	
AA Centroid Latitude	
AA Centroid Longitude	
AA Size (Hectares)	
Approximate Length of AA	100
Average Bankful Width	19.8
Flowing water at time of assessment?	No
Apparent Hydrologic Flow Regime	intermittent
Tidal Stage	not recorded
Is this a public record?	No
AA Comment	This AA is located in San Simeon Creek approximately 125 meters from the CSD well field. Dry season flows may be altered by the ground water extraction. German ivy has invaded the riparian corridor and is negatively affecting the lower and mid strata vegetation. The assessment was conducted during a drought. The area has not received average precipitation in three years.

Metric Scores

Attribute	Buffer And Landscape Context	90.29
	Stream Corridor Continuity	A (12)
	Percent Of AA With Buffer	A (12)
	Average Buffer Width	B (9)

	Buffer Condition	B (9)
Attribute	**Hydrology**	**66.67**
	Water Source	C (6)
	Channel Stability	B (9)
	Hydrologic Connectivity	B (9)
Attribute	**Physical Structure**	**87.50**
	Structural Patch Richness	A (12)
	Topographic Complexity	B (9)
Attribute	**Biotic Structure**	**80.56**
	Number Of Plant Layers Present	A (12)
	Number Of Co-Dominant Species	A (12)
	Percent Invasion	B (9)
	Plant Community Score	11
	Horizontal Interspersion And Zonation	C (6)
	Vertical Biotic Structure	A (12)
Index Score		**81**

Stressors **3** total, **1** with significant negative effect - *indicated below with* *

Attribute	**Biotic Structure**
	Lack of treatment of invasive plants adjacent to AA or buffer*
Attribute	**Buffer And Landscape Context**
	Transportation corridor
Attribute	**Hydrology**
	Groundwater extraction

This report was created on Thursday May 28, 2015, 10:00 AM using the SFEI eCRAM Mapper at www.cramwetlands.org

The data provided in this report is for informational purposes only and may not be sufficient for the purposes of fulfilling the requirements of a regulatory permit. Please see "Using CRAM (California Rapid Assessment Method) To Assess Wetland Projects As an Element of Regulatory and Management Programs" CWMW, Oct. 13, 2009.

WWW.CRAMWETLANDS.ORG

CRAM

California Rapid Assessment Method

Exhibit 10.2

Summary Assessment Report

Assessment not mapped

Basic Information

eCRAM ID	4075
Assessment Area Name	San Simeon 3
Project Name	
Assessment Area ID	San Simeon Creek/Lagoon
Project ID	Cambria Emergency Water
Wetland Type	riverine non-confined
CRAM Version	6.1

Visit Date	2015-05-22
AA Category	
Practitioners	Travis Belt (lead practitioner)
Other Practitioners	Ben Hart
County	
Ecoregion	
AA Centroid Latitude	
AA Centroid Longitude	
AA Size (Hectares)	
Approximate Length of AA	100
Average Bankful Width	19.2
Flowing water at time of assessment?	No
Apparent Hydrologic Flow Regime	perennial
Tidal Stage	not recorded
Is this a public record?	No
AA Comment	The AA is located in the lower reach of San Simeon Creek approximately 1,200 feet upstream of the creek's mouth on the beach. The Van Gordon Creek Road bridge crosses the lower portion of the AA. The AA is located approximately 675 feet from the WTP percolation ponds and 3000 feet downstream of the freshwater extraction wells. The vegetation is dominated by willows. The water in the creek was stagnant (not flowing) with very bad quality and severe algae growth.

Exhibit 10.2

Metric Scores

Attribute	Buffer And Landscape Context	90.29
	Stream Corridor Continuity	A (12)
	Percent Of AA With Buffer	A (12)
	Average Buffer Width	B (9)

Exhibit 10.2

	Buffer Condition	B (9)
Attribute	**Hydrology**	**83.33**
	Water Source	C (6)
	Channel Stability	A (12)
	Hydrologic Connectivity	A (12)
Attribute	**Physical Structure**	**62.50**
	Structural Patch Richness	C (6)
	Topographic Complexity	B (9)
Attribute	**Biotic Structure**	**63.89**
	Number Of Plant Layers Present	A (12)
	Number Of Co-Dominant Species	D (3)
	Percent Invasion	B (9)
	Plant Community Score	8
	Horizontal Interspersion And Zonation	C (6)
	Vertical Biotic Structure	B (9)
Index Score		**75**

Stressors **5** total, **2** with significant negative effect - *indicated below with* *

Attribute	**Biotic Structure**
	Lack of treatment of invasive plants adjacent to AA or buffer
Attribute	**Buffer And Landscape Context**
	Active recreation (off-road vehicles, mountain biking, hunting, fishing)
Attribute	**Hydrology**
	Actively managed hydrology*
	Engineered channel (riprap, armored channel bank, bed)
Attribute	**Physical Structure**
	Nutrient impaired (PS or Non-PS pollution)*

This report was created on Thursday May 28, 2015, 3:12 PM using the SFEI eCRAM Mapper at www.cramwetlands.org

The data provided in this report is for informational purposes only and may not be sufficient for the purposes of fulfilling the requirements of a regulatory permit. Please see "Using CRAM (California Rapid Assessment Method) To Assess Wetland Projects As an Element of Regulatory and Management Programs" CWMW, Oct. 13, 2009.

Exhibit 10.2

WWW.CRAMWETLANDS.ORG

CRAM

California Rapid Assessment Method

Summary Assessment Report

Assessment not mapped

Basic Information

eCRAM ID	4074
Assessment Area Name	San Simeon 2
Project Name	
Assessment Area ID	Van Gordon Creek
Project ID	Cambria Emergency Water
Wetland Type	riverine non-confined
CRAM Version	6.1

Visit Date	2015-04-22
AA Category	
Practitioners	Travis Belt (lead practitioner)
Other Practitioners	Ben Hart
County	
Ecoregion	
AA Centroid Latitude	
AA Centroid Longitude	
AA Size (Hectares)	
Approximate Length of AA	100
Average Bankful Width	5.5
Flowing water at time of assessment?	No
Apparent Hydrologic Flow Regime	
Tidal Stage	not recorded
Is this a public record?	No
AA Comment	The AA is located in Van Gordon Creek approximately 100 feet downstream of a gravel low water crossing and approximately 650 feet upstream of the Van Gordon Creek and San Simeon Creek confluence. The wastewater treatment plant percolation ponds are approximately 100 feet from the AA boundary. The brackish water extraction wells are approximately 700 feet from the AA boundary. Van Gordon Creek was dry at the time of the assessment and appeared that it had not flowed in the 2014/2015 season. Lack of flow may have been due to drought conditions and the ephemeral nature of the creek. The low and mid-strata vegetation in the AA has significant coverage of Vinca major and German ivy. The upper strata is all willow. The banks of the creek are uniform throughout the AA.

Exhibit 10.2

Metric Scores

Attribute	Buffer And Landscape Context	79.75

Exhibit 10.2

	Stream Corridor Continuity	A (12)
	Percent Of AA With Buffer	A (12)
	Average Buffer Width	C (6)
	Buffer Condition	C (6)
Attribute	**Hydrology**	**83.33**
	Water Source	C (6)
	Channel Stability	A (12)
	Hydrologic Connectivity	A (12)
Attribute	**Physical Structure**	**37.50**
	Structural Patch Richness	D (3)
	Topographic Complexity	C (6)
Attribute	**Biotic Structure**	**63.89**
	Number Of Plant Layers Present	A (12)
	Number Of Co-Dominant Species	C (6)
	Percent Invasion	C (6)
	Plant Community Score	8
	Horizontal Interspersion And Zonation	C (6)
	Vertical Biotic Structure	B (9)
Index Score		**66**

Stressors

4 total, **1** with significant negative effect - *indicated below with* *

Attribute	**Biotic Structure**
	Lack of treatment of invasive plants adjacent to AA or buffer*
Attribute	**Buffer And Landscape Context**
	Transportation corridor
Attribute	**Hydrology**
	Point Source (PS) discharges (POTW, other non-stormwater discharge)
Attribute	**Physical Structure**
	Vegetation management

This report was created on Thursday May 28, 2015, 1:09 PM using the SFEI eCRAM Mapper at www.cramwetlands.org

APPENDIX E

California Steelhead Trout and Tidewater Goby Visual Surveys for the Cambria Community Services District Emergency Water Supply Project

Cindy Cleveland
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December 17, 2015

Rita Garcia
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RE: California Steelhead Trout and Tidewater Goby Visual Surveys for the Cambria Community Services District Emergency Water Supply Project

Dear Ms. Garcia,

This report presents the findings of the south-central California coast steelhead (*Oncorhynchus mykiss*) DPS (Distinct Population Segment) and tidewater goby (*Eucyclogobius newberryi*) visuals surveys for the Cambria Community Services District (CCSD) Emergency Water Supply Project (Project) located in San Luis Obispo County, California. The Project is located between the communities of San Simeon to the north and Cambria to the south (Figure 1). The CCSD completed the Cambria Emergency Water Supply Project to help alleviate an emergency water shortage in the Community of Cambria. The Project treats brackish water to produce potable water that is injected into a water recharge well for use in the groundwater basin. The Project is located on CCSD's San Simeon well field and percolation pond system property located east of Van Gordon Creek Road and south of San Simeon-Monterey Creek Road.

Historically, tidewater goby surveys have been conducted in San Simeon Creek Lagoon in early summer and early fall to measure the species' status immediately after sandbar closure and immediately before the sandbar opens again. Steelhead trout have been surveyed for in lower San Simeon Creek in the summer after young steelhead had hatched. Surveys for these two species were conducted during these same time periods, in order to capture consistent data with what has historically been evaluated and to continue building a database of fish presence, however, due to the lack of access outside of CCSD property, the study area was only upstream of Van Gordon Bridge. Cleveland biologists conducted two rounds of visual surveys for tidewater goby and a single visual survey for steelhead trout.

1.0 Species Background and Study Area History

1.1 Tidewater Goby

Tidewater gobies are listed as a Federally threatened species under the Endangered Species Act. Tidewater gobies were originally listed as endangered on March 7, 1994, however, this listing was reclassified as threatened on March 13, 2014. Tidewater gobies critical habitat was designated and a new proposal for critical habitat is under review (USFWS 2015b). Currently, the study area is located in tidewater goby critical habitat (USFWS 2015a).

The tidewater goby is a small, elongate, fish rarely exceeding 2 inches and has large pectoral fins (USFWS 2015b). The tidewater goby usually lives for only about 1 year and may occur in populations with a few to thousands of individuals (USFWS 2015b). Reproduction peaks in spring and late summer but may occur year round (USFWS 2015b). Male gobies dig a vertical nesting burrow 10 to 20 centimeters deep in substrate while the female tidewater gobies lay 300 to 500 eggs (USFWS 2015b).

The tidewater goby is found in year round California coastal lagoons, estuaries, and marshes (USFWS 2015b). Tidewater gobies do not occur in areas where the coastline is steep and there are no lagoons or estuaries (USFWS 2015b). They live at the bottom of shallow, brackish water in lagoons and lower stream reaches (USFWS 2015b). Tidewater gobies prefer a sandy substrate for breeding and may have a wide tolerance for salinity, oxygenation, and temperature, especially over short time periods or seasonally (USFWS 2015b). Adult tidewater gobies may be flushed into marine habitats seasonal breaching of the sandbars following but may not survive for long periods in the marine environment (USFWS 2015b). The tidewater goby has been documented in slack freshwater habitats as far as 5 miles upstream from San Antonio lagoon in Santa Barbara County (USFWS 2015b). Tidewater gobies have been sampled in San Simeon Creek Lagoon (RBF Consulting 2015). In 2014 1,002 tidewater gobies were seined in San Simeon Lagoon (RBF Consulting 2015).

1.2 Steelhead Trout

Steelhead trout are listed as a Federally threatened species under the Endangered Species Act. Steelhead trout were originally listed on January 5, 2006 and the listing was updated on April 14, 2014 (NOAA 2015). Steelhead trout critical habitat is designated and the study area is located in steelhead trout critical habitat (NOAA 2015). In the study area steelhead trout are within the south-central California coast steelhead DPS (NOAA 2015).

Steelhead trout are silvery-white on the underside with a heavily speckled body and a pink to red stripe along their sides (NOAA 2015). Steelhead trout are hatched in cool, fast running streams where they stay in fresh water and some move to marine habitats (NOAA 2015). The fish that stay in fresh water are called rainbow trout. The fish that migrate to the ocean are called steelhead trout. Steelhead trout are usually larger than rainbow trout. Young steelhead trout feed primarily on zooplankton and adults feed on aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, and other small fishes (NOAA 2015).

Juvenile steelhead may spend up to 7 years in freshwater before migrating to the ocean for up to 3 years before migrating back to freshwater to spawn (NOAA 2015). Adult female steelhead prepare a redd (or nest) in a stream and may deposit eggs in 4 to 5 "nesting pockets" within a single redd. Steelhead trout can live in a wide range of temperature conditions. Steelhead trout are found along the entire Pacific Coast. Steelhead trout have been documented in San Simeon Creek and lagoon (RBF Consulting 2015). CDFG performed Stream Habitat Inventories on San Simeon Creek in 1973 and 1992 (USGS 1998).

2.0 Methodology

Cindy Cleveland and Paul Cleveland conducted tidewater goby and steelhead trout surveys on July 8, August 12, and October 2, 2015. The surveys were conducted within the study area that extended from Van Gordon Bridge upstream for approximately 400 feet and continued upstream till water flow ran subsurface approximately 0.5 miles upstream from Van Gordon Bridge (Figure 2).

Prior to the fieldwork, Cindy Cleveland conducted a review of documents concerning the Project site and the surrounding areas, including a search of the California Natural Diversity Database (CDFW 2015a and CDFW 2015b). Other resources utilized for this summary report included various State and Federal regulations and aerial photographs.

The survey consisted of walking around the Project site study area and surrounding areas to characterize the habitat, assess site conditions, and visually observed fish species.

3.0 Results

The study area is located at 35°35'44"N/121°07'27"W, with agricultural uses to the north, San Simeon State Park to the south and west, and the onsite CCSD percolations ponds and wells on the northeast and east portions of the study area, respectively. Beyond San Simeon State Park and CCSD property are rolling hills that support livestock, agricultural crops and native habitats. San Simeon Creek is mostly unconsolidated alluvium underlain by bedrock (USGS 1998). The main stem of San Simeon Creek dries up during the summer months (USGS 1998).

The banks of San Simeon Creek are lined with Central Coast Arroyo Willow Riparian Forest dominated by dense stands of arroyo willow (*Salix lasiolepis*). The willows provided approximately 40% overhead cover. No fish species except for three-spined stickleback (*Gasterosteus aculeatus*) were observed in the study area.

3.0 Conclusion

The Project site study area contains high quality habitat for tidewater goby and steelhead trout. If you have any questions or need additional information, please contact Cindy Cleveland at 805.234.3759.

Sincerely,

Cindy Cleveland

Enclosures:

- Figure 1: Project Site Location Map
- Figure 2. Project Study Area Location Map
- Attachment 1: References

FIGURE 1

Project Site Location Map

Exhibit 10.2

Figure 1. Project Site Location Map

Exhibit 10.2

FIGURE 2

Project Site Study Area Location Map

Exhibit 10.2

Figure 2. Project Site Study Area Location Map

ATTACHMENT 1

References

California Department of Fish and Wildlife (CDFW). 2015a. Biogeographic Information and Observation System. Available online at: http://bios.dfg.ca.gov/.

California Department of Fish and Wildlife (CDFW). 2015b. California Natural Diversity Database. Available online at: http://www.dfg.ca.gov/biogeodata/cnddb/.

NOAA Fisheries. 2015. Steelhead Trout. Available online at: http://www.fisheries.noaa.gov/pr/species/fish/steelhead-trout.html.

RBF Consulting, A Michael Baker International Company (RBF Consulting). Cambria Emergency Water Supply Project. Adaptive Management Plan. Prepared for Cambria Community Services District. January 2015.

U.S. Fish and Wildlife Service (USFWS). 2015a. Critical Habitat Portal. Available online at: http://ecos.fws.gov/crithab/.

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APPENDIX F

Final 2015 California Red-legged Frog Field Survey for the Cambria Community Services District Emergency Water Supply Project

Cindy Cleveland
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805.234.3759

December 10, 2015

Rita Garcia
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949.472.3454

RE: Final 2015 California Red-legged Frog Field Survey for the Cambria Community Services District Emergency Water Supply Project

Dear Ms. Garcia,

This report presents the findings of the 2015 California red-legged frog (*Rana draytonii*) field surveys for the Cambria Community Services District (CCSD) Emergency Water Supply Project (Project) located in San Luis Obispo County, California. The Project is located between the communities of San Simeon to the north and Cambria to the south (Figure 1). The CCSD completed the Cambria Emergency Water Supply Project to help alleviate an emergency water shortage in the Community of Cambria. The Project treats brackish water to produce potable water that is injected into a water recharge well for use in the groundwater basin. The Project is located on CCSD's San Simeon well field and percolation pond system property located east of Van Gordon Creek Road and south of San Simeon-Monterey Creek Road.

This survey is a follow-up survey to a September 29 and October 5, 2014 focused California red-legged frog survey completed by RBF Consulting, a Michael Baker International Company (RBF Consulting 2015). The RBF Consulting focused surveys were to establish baseline California red-legged frog population data for the Project. The RBF Consulting focused surveys verified the presence of and estimated the number of California red-legged frogs in San Simeon Lagoon and lower San Simeon Creek. This field survey duplicated RBF Consulting focused surveys but there was no handling, capture, or "take" of California red-legged frogs (per U.S. Fish and Wildlife guidance) and the study area was located on CCSD property, upstream of Van Gordon Bridge (study area).

1.0 Species Background

Federally listed California red-legged frogs are the largest native frog in the western United States (USFSW 2010). Historically, California red-legged frogs occurred in California and Baja California from sea level to approximately 5,000 feet (USFWS 2010). The lower abdomen and underside of the hind legs are usually red or pink in color and they have prominent dorsal folds (USFWS 2000).

Breeding for the California red-legged frog takes place from late November to late April (USFWS 2000) but can vary depending on seasonal variations (USFWS 2010). Males usually show up at breeding pools two to four weeks ahead of females and commence vocalizations. Egg masses are laid in pools among emergent vegetation, twigs, or other structures (USFWS 2010). Eggs hatch in 6-14 days and tadpoles metamorphose in 3.5-7 months. California red-legged frogs may live up to ten years. Habitat for California red-legged frogs includes still or slow moving water in ponds, reservoirs, marshes, streams, and other permanent bodies of water and the surrounding upland habitats (USFWS 2000).

2.0 Methodology

Cindy and Paul Cleveland and Kevin Merk conducted two daytime and two nighttime California red-legged frog surveys following the survey protocol contained in the "Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog" (USFWS 2005) on February 25 and April 1, and August 14, and October 2, 2015. On September 22, 2015 the Project was turned on and to capture any impacts to California red-legged frogs, the last frog survey took place on October 2, 2015. The surveys were conducted within the study area that extended from Van Gordon Bridge upstream for approximately 400 feet (Figure 2).

Prior to the fieldwork, Cindy Cleveland conducted a review of documents concerning the Project site and the surrounding areas, including a search of the California Natural Diversity Database (CDFW 2015a and CDFW 2015b). Other resources utilized for this summary report included various State and Federal regulations and aerial photographs.

The daytime survey consisted of walking around the Project site study area and surrounding areas to characterize the habitat, assess site conditions, and prepare for the nighttime survey. Nighttime surveys consisted of walking upstream from Van Gordon Bridge, using Nite Lite Wizard II headlamps and Vortex Viper HD 8 X 40 binoculars, scanning for eyeshine and identifying all amphibians observed.

3.0 Results

According to the CNDDB there are multiple occurrences of California red-legged frogs in and around the study area. The earliest known records of California red-legged frogs in the study area are from 1992 (RBF 2015). The author (Cindy Cleveland) found California red-legged frogs in the study area in a 1997 survey. The RBF Consulting (2015) survey consisted of two mark-recapture night surveys with a total of 53 California red-legged frogs either captured or escaped. California red-legged frogs are also known to occur in watersheds that are within two miles of the study area: Pico Creek (Cindy Cleveland pers. ob.), Leffingwell Creek and Santa Rosa Creek (RBF 2015). The entire study area is located in California red-legged frog critical habitat (USFWS 2015).

The study area is located at 35°35'44"N/121°07'27"W, with agricultural uses to the north, San Simeon State Park to the south and west, and the onsite CCSD percolations ponds and wells on the northeast and eastern portions of the study area, respectively. Beyond San Simeon State Park and CCSD property are rolling hills that support livestock, agricultural crops and native habitats. San Simeon Creek is mostly unconsolidated alluvium underlain by bedrock (USGS 1998). The main stem of San Simeon Creek dries up during the summer months (USGS 1998).

The nighttime surveys were completed between the hours of 1900 and 2200. For the February 25, 2015 survey, daytime temperature was 60 degrees Fahrenheit, nighttime temperature was 54 degrees Fahrenheit, wind speed was 2 miles per hour, cloud cover was 2%, and the moon was 50% full.

For the April 1, 2015 survey, daytime temperature was 59 degrees Fahrenheit, nighttime temperature was 55 degrees Fahrenheit, wind speed was 2-3 miles per hour, cloud cover was 0%, and the moon was 70% full.

For the August 14, 2015 survey, daytime temperature was 69 degrees Fahrenheit, nighttime temperature was 56 degrees Fahrenheit, wind speed was 2-3 miles per hour, cloud cover was 0%, and the moon was 0% full.

For the and October 2, 2015 survey, daytime temperature was 68 degrees Fahrenheit, nighttime temperature was 57 degrees Fahrenheit, wind speed was 2-3 miles per hour, cloud cover was 30%, and the moon was 75% full.

For the February 25, 2015 survey, San Simeon Creek water depth varied from 2 feet to 4 feet. Bankfull width was approximately 32 feet and bankfull depth was approximately 6 feet. There was a 1% slope in the study area. San Simeon instream substrates were approximately 20% silt, 60% gravel, and 20% cobble with some bedrock banks. There was one bedrock pool, approximately 3 feet deep in the study area; the rest of the study area was a glide with frog habitat created by willow rootwads. Water clarity was excellent (see Attachment 2 Photographs). For the April 1, 2015 survey the only change from the February 25, 2015 survey was a slight lowering of the bankfull depth and width and for the August 14 and October 2, 2015 survey the only changes were that the water levels were slightly lower and water clarity was poor due to algae growth (see Attachment 2 Photographs).

The banks of San Simeon Creek are lined with Central Coast Arroyo Willow Riparian Forest dominated by dense stands of arroyo willow (*Salix lasiolepis*; see Attachment 2 Photographs). The willows provided approximately 40% overhead cover.

For the February 25, 2015 survey two juvenile and two adult California red-legged frogs were visually observed and three California red-legged frogs were auditorily located. For the April 1, 2015 survey one adult and nine juvenile California red-legged frogs were observed and one possible bullfrog was observed. The identification of the bullfrog is unclear; it was visually observed for a few seconds before it went into the water, but without a squeak. For the August 14, 2015 survey two juveniles, three adults, two tadpoles, and one metamorph were observed. For the October 2, 2015 survey three subadults and four adults were observed. The operation of the Project did not appear to have impacted water levels or California red-legged frogs after operating for eleven days.

3.0 Conclusion

The Project site study area contains high quality habitat for California red-legged frogs. The 2015 surveys identified a stable breeding population of California red-legged frogs in the study area. If you have any questions or need additional information, please contact Cindy Cleveland at 805.234.3759.

Sincerely,

Cindy Cleveland

Enclosures:

- Figure 1: Project Site Location Map
- Figure 2. Project Study Area Location Map
- Attachment 1: References
- Attachment 2: Photographs

FIGURE 1

Project Site Location Map

Exhibit 10.2

Figure 1. Project Site Location Map

FIGURE 2

Project Site Study Area Location Map

Exhibit 10.2

Figure 2. Project Site Study Area Location Map

ATTACHMENT 1

References

California Department of Fish and Wildlife (CDFW). 2015a. Biogeographic Information and Observation System. Available online at: http://bios.dfg.ca.gov/.

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U.S. Fish and Wildlife Service (USFWS). 2010. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the California Red-Legged Frog. Federal Register Vol. 75, No. 51.

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ATTACHMENT 2

Photographs

Exhibit 10.2

Figure 1. Study area water quality on February 25, 2015.

Figure 2. Study area looking east on February 25, 2015.

Figure 3. Study area looking east on August 14, 2015.